SCIENTIFIC AMERICAN

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Double auroral arc with vertical rays in the upper arc (August 29th, 1902, 2 h. A. M.) as seen within the Antarctic Circle.

Study of an auroral curtain made on July 5th, 1902 (1 h. A. M. to 2 h. A. M.) during the National Antarctic Expedition (1901).

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FORMS OF THE AURORA AUSTRALIS.—See page 424.]

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NEW YORK, SATURDAY, JUNE 5th, 1909.

The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

A WORD TO AEROPLANE BUILDERS

If it were possible to take count of the number of people in the United States who are to-day engaged in building some form of heavier-than-air flying machine, whether aeroplane, helicopter, or ornithopter, the size of the total would probably be a matter of no small surprise. When an age-long problem of such difficulty as that of the human mastery of flight is solved in a sudden and sensational manner, as by the Wright brothers last year, a stimulus is given to the art, the effect of which is seen in the immediate effort of people of an inventive and more or less mechanical turn of mind, to emulate if not surpass the achievement. Much of this endeavor, probably most of it, is doomed to failure; chiefly because the experimentalist does not realize the extreme difficulty of the problem, both from the theoretical and mechanical standpoint, and labors under the mistaken impression that a machine which is a broad imitation of the original must of itself necessarily fly.

Light-weight motors may be bought in the open market; but for the construction of an aeroplane itself two things are absolutely necessary: first, a thorough knowledge of the unchangeable principles upon which the aeroplane is based, and second, an intimate knowledge of the strength of materials, of the stresses to which the aeroplane will be subjected, and of the best way to dispose this material so as to secure in the finished machine the maximum of strength with the minimum of weight. It was only last week that the Editor was invited to witness the trial flight of an aeroplane, on the construction of which a large amount of time and money had been spent. Asked for his opinion as to the probabilities of flight, he replied that it could never by any possibility get off the ground; and it never did. It was evident at first sight that, although the supporting area was large, the question of weight saving had been so completely neglected, that in spite of the large horse-power with which it was equipped and the generous amount of bearing surface, the weight of the machine, which must have been close to 2,000 pounds, was altogether prohibitive. And yet, from a distance, it had all the appearance of delicacy and lightness which is characteristic of the biplane type. Only on closer inspection was the neglect of weight saving everywhere evident. Instead of sawing off the projecting ends of the ribs on the two planes, they had been left in place, thereby adding considerably to the total weight. Projecting threaded ends of bolts, which should have been sawn close, had not been removed—an item of useless weight that represented not a few pounds in the total. The chassis, or frame for traveling upon the ground when rising or alighting, had been put together without any careful consideration of the stresses involved, and was heavy beyond all reason.

It may be said, once and for all, that the "rule of thumb" and the "cut and try again" method can never be applied to aeroplane building without involving a large amount of useless expenditure of time and money. Already, sufficient experimental work has been done, and the results published, to place within reach of the would-be builder of one of these machines sufficient data to enable him to go about his work intelligently. The lifting power per square foot of area, the best angle of flight, the thrust obtainable with a given type of propeller running at a given speed, and many other useful data have been made public, and we advise all would-be experimentalists in mechanical flight to make themselves familiar with as much of this literature as they can lay their hands upon, before determining upon the dimensions of their machines.

Unquestionably, the most important element as far as the mechanical construction is concerned, apart from the selection of the proper motor, is that of weight saving. We are all of us familiar with the success achieved by Herreshoff in the construction of yachts for the defense of "America's" Cup. The secret of his success lay, not so much in the form of the hull as in the all-round lightness of the construction. Herreshoff was before everything else an engineer; and it was his ability to apply his material in exact proportion to the stresses, that was responsible for the extraordinary combination of lightness and power which characterized his yachts.

Now the weight problem is of even greater importance in the aeroplane than it is in the sailing yacht. The amateur builder, as far as his purse will allow, should select materials which combine lightness and strength. He should carefully study the nature and amount of the strains to which his machine will be subjected, and dispose his materials accordingly. Let him remember that the total saving in weight is due to the elimination of a pound here and a few ounces there. No economy in detail is so small that he can afford to neglect it.

NAVAL PROGRAMME FOR 1911.

According to the announcement recently made by Secretary Meyer of the Navy, it is the intention of the Administration to devote the greater part of the appropriations for new construction during the year 1911 to the building of two battleships of the "Wyoming" type, each to be of 26,000 tons displacement. Comparatively little of the appropriation will be used in the construction of smaller craft. It is likely that, outside of the battleships, the additions to the navy will consist of either five torpedo-boat destroyers or one modern repair ship for the fleet. We are gratified to learn that the decrease in the 1911 naval estimates of $10,000,000 is to be accomplished without making any reduction in the number of battleships which Congress recently decided should be added annually to our navy to maintain it at its proper standard of strength. In view of the large preponderance of battleships over vessels of other classes in our navy, and the fact that these ships are armed with the heaviest guns, Congress is probably right in its conviction that the annual addition of two battleships of such great size and power as our new 26,000 ton ships will be sufficient for our needs, at least for the present. Should the international situation at any time warrant a larger annual increase, our leading yards have shown that they are well able to meet the demand.

The two battleships planned for 1911 will be similar to the "Arkansas" and "Wyoming." On a displacement of 26,000 tons they will carry twelve 12-inch guns in six turrets placed on the center line of the ship. They will be driven by turbine engines at a speed of 20½ knots, and their bunkers will have a capacity of 3,000 tons of coal. The side armor extending from six feet below the waterline to the upper deck, will taper gradually from 11 inches in thickness at the water to 6½ inches at the level of the main deck. The defense against torpedo attack will be particularly powerful, consisting of no less than twenty-two 5-inch rapid fire guns, 50 calibers in length. In point of size, coal endurance, and power of attack and defense, these are the most powerful designs that have received official sanction in any navy. With the completion of the two ships, the navy will have a squadron of eight battleships of the same general type, possessing the same tactical qualities, and admirably suited for joint maneuvers.

THE PROPOSED NEW WATERWAY IN CANADA.

In view of the fact that New York State is spending over one hundred millions for the construction of a State barge canal with a depth of twelve feet, to improve water communication between the Great Lakes and the Atlantic, great interest attaches to the Georgian Bay Canal, which is designed to shorten the distance between Montreal and Lake Huron by the construction of a ship canal twenty-two feet in depth. The route is *via* Georgian Bay, the French and Pickerel Rivers, Lake Nipissing, and the Ottawa River, the total distance being 440 miles. Although there will be a total of twenty-seven locks, it is estimated that there will be a saving of a day or more in time over the present route for steamships through the Lakes. The saving in distance on the route *via* the canal from Lake Superior to London, as compared with the route *via* the New York barge canal, will be 806 miles. The topographical features along the canal are such that 332 miles of the distance will consist of natural waterways, upon which no work of excavation need be done. Of the remaining 108 miles, 80 miles will consist of submerged channels, on which there will be only a limited amount of excavation in the removal of rocks and shoals. This leaves about 28 miles of canal in which the full prism must be excavated in cuts that vary from 200 to 300 feet in width. The summit level will be 99 feet above Georgian Bay and 659 feet above Montreal. The estimated total cost of the canal is about the same as that of our State barge canal, or about $100,000,000, and the estimated time to complete the work is about ten years.

It would be fatuous to close our eyes to the important bearing which this scheme has upon our smaller waterway from Lake Erie to the Hudson. The one, with its limited draft, can take nothing larger than a 1,000-ton barge; the other, with its minimum draft of twenty-two feet, will be able to pass ocean-going freight steamships from ports on the Lakes to the Atlantic. The advantages of carrying freight in large bulk and without rehandling are well understood. There is a saving both of time and cost. On the other hand, the opening of a ship canal from the Lakes to the ocean would not render the whole fleet of lake steamers available for coastwise traffic between the Lakes and the ports on our own seaboard, or service in the transatlantic trade. It is urged by the commercial interests which would be affected that the average lake steamer is not suitable for deep-sea service; the type of ship that is adapted for service on the Lakes being in some respects unsuited for over-sea voyages. This may be true of some of the smaller craft; but we doubt if it would apply to the ships of larger displacement, which constitute the bulk of the more modern lake fleets. After all is said and done, it is certain that, with the near approach of the completion of the Georgian Bay Canal, vessels suitable for combined lake and ocean voyages will be constructed.

STORAGE OF COAL UNDER WATER.

The storage of coal under water has been proposed as a remedy for two great inconveniences of the common method of storage—danger of spontaneous combustion and deterioration of the quality of the fuel. Coal, when freshly mined, is very easily affected by chemical, mechanical, and physical agencies. The effect of exposure to the atmosphere is a gradual diminution of the value of the coal in consequence of a loss of calorific power and substance, and a deterioration in the quality of the gas and coke obtained from it.

The first action is a rapid absorption of oxygen which is partly retained by the pores of the coal and partly combined chemically, with the formation of water and carbon dioxide and a disengagement of heat. This effect is particularly noticeable in fine coal, which exposes a large surface to the air. During the storage the gas-producing power of the coal also diminishes. If oxidation is increased artificially it may be observed that the coke produced from the coal does not cohere, and that the gas consists largely of hydrogen and gives little light. The value of the by-products is also diminished. The gases evolved by piles of coal consist chiefly of methane, mixed with very variable quantities of carbon dioxide, and in certain cases of carbon monoxide, higher hydro-carbon and even nitrogen. The absorption of water is very variable, from 4 to 10 per cent. Grundmann's researches show that, in regard to calorific power, a medium coal containing 5 to 10 per cent of ash and as much of hygroscopic water and producing 6,500 or 7,000 calories lost at least 4 per cent of its value in four weeks, 9 per cent in six months, and 12 per cent in one year. In certain climates the loss in a year amounts to 20 or 30 per cent.

Spontaneous combustion is always to be feared in large masses of coal. It has been proved that the temperature of English coal freshly stored rises in two or three days to from 70 to 85 deg. F. and thereafter continues between 85 and 100 deg. F. Water may accelerate this rise of temperature by bringing oxygen in solution. Special care should be taken not to deposit dry coal upon any large quantity of damp coal. Wet coal should be spread in layers 8 inches thick and allowed to dry 24 hours before being covered with a new layer. Sulphur compounds do not play an important part in spontaneous ignition. Pyrites resists atmospheric influences well, with the exception of the variety called marcassite which tends to decompose in the presence of water. The practice of ventilating piles of coal by means of little shafts and canals, although recommended by insurance companies, is rather injurious than otherwise, as it facilitates the absorption of oxygen. If ventilation is attempted, it should be mechanical and very energetic in order to produce a refrigeration which will counterbalance the oxidizing effect of the air.

An interesting article in The Automobile disposes of some fallacies in connection with the gyroscopic action of automobile flywheels. It has been suggested that advantages comparable with the action of the Schlick gyroscope on ships or mono-railways are obtainable by the placing of flywheels in unusual positions in four-wheeled cars, and the writer clearly points out that conditions essential to the steadying effect of a gyroscope are non-existent in an ordinary automobile.

ENGINEERING.

The many improvements which have been made both in track and rolling stock, to say nothing of the introduction of block signaling, are beginning to tell in the direction of lowering the list of fatalities and injuries. The Pennsylvania Railway is to be congratulated on its remarkable record of the past year, during which, although it carried a total of 141,659,543 passengers, not one was killed.

As a result of the visit of the Secretary of War and the Chief of Staff to the Isthmus, tentative plans for the defense of the Panama Canal have been adopted, which embody the following features: There will be three batteries, located on the islands lying from ten to fifteen miles from the entrance; and other batteries will be placed on the coast line near the mouth of the canal. Six miles up the canal will be a battery for the defense of the Pedro Miguel lock. There will be a military post at Culebra. The Atlantic entrance will be defended by batteries upon the range of hills commanding the entrance. Altogether, sixty of the highest power disappearing guns will be mounted.

The army 16-inch gun, which is the most powerful weapon in existence to-day, is still at Sandy Hook mounted on the temporary carriage which was used for its trials. It has been proposed to ship the gun to the Philippines, and mount it in the fortifications which are now being built at Corregidor Island for the defense of Manila. The 12-inch gun is not able to completely command the channel; but the 16-inch gun could strike a blow, even at a distance of 11,000 feet, which, if it got fairly home, would probably disable any modern battleship. Although there is no likelihood of another 16-inch gun being built, this costly weapon should at least be mounted in some position where it can render effective service.

The United States Weather Bureau is making a study of evaporation at the Salton Sea, and an extensive plant has been constructed, with which a thorough research will be made of the question of evaporation of water in the open air over large lakes and reservoirs. The sea, which is 50 miles long by 18 wide, was formed, it will be remembered, by a break in the Colorado River, and climatic conditions are such as will render the data which will be secured particularly applicable to the reservoirs now being constructed by the United States Reclamation Service. Four observation towers have been built, each containing several platforms at different elevations. On these platforms are iron pans filled with water, observations of which are taken every four hours.

The great increase which has taken place of late years in the size of locomotives, has added greatly to the labors of the fireman. This has led to much experimental work, in an effort to produce a good mechanical stoker. The Chicago & Alton Railway have formally adopted the Strause stoker, with which they are equipping all their heavy freight and passenger locomotives. Coal is thrown into a bin, from which it is delivered to different parts of the grate by varying the speed of a plunger, which is controlled by a starting lever. The advantages are that air admission is controlled; small amounts of coal are fed at frequent intervals; and larger nozzles may be used and back pressure reduced. The results will be closely watched by the railroad companies.

The German government has decided to abolish magnetic compasses from German warships and replace them with the gyroscope compass invented by Dr. Anschuetz-Haempfe, which has proved "a brilliant success." The device consists of a 9-pound wheel, mounted with the usual compass card in a holder of quicksilver. An electric motor rotates the wheel at 21,000 turns a minute. After it has run for two hours, the instrument is set in the direction of the mathematical meridian, which position it keeps unchanged, being unaffected by neighboring iron and steel, and unsusceptible to vibration and rolling. On one occasion, during a nine months' cruise of the battleship "Deutschland," the magnetic compass, although left entirely to itself, maintained its true direction for a month.

The largest of all the schemes of reclamation contemplated by the government has recently been undertaken by the engineers in the Sacramento Valley. Its ultimate object is to control the flow from a watershed of over 4,000 square miles, and to improve the two great rivers of California. When the task is completed, over 600,000 acres of rich land, which at present is dry and sun-baked during eight months of the year, will have been brought under irrigation, and large areas of bottom land, which at present are subject to annual overflow and great destruction by the floods, will have been reclaimed. Furthermore, the works involved in this reclamation will involve the control of sufficient water power to provide electric light and power over the greater part of the Sacramento Valley, which extends for 450 miles from Mount Shasta to San Francisco Bay, and at its widest part reaches about 100 miles from mountain range to mountain range.

ELECTRICITY.

The government is calling for bids on a concrete tower 600 feet high, and tapering from a base 50 feet in diameter to 8 feet at the top. This tower is to be used for the 3,000-mile wireless telegraph station which is to be built for the Navy Department. The tower will be situated in Rock Creek Park, Washington, D. C., and it is hoped from this station that the Navy Department can keep in touch with vessels of the navy at any point on the North Atlantic Ocean.

A recent press dispatch speaks of a secret invention of Sir Percy Scott, whereby the large guns of warships may be electrically controlled. According to the report, this system was recently tried out with very satisfactory results on the British cruisers "Good Hope," "Argyl," and "Arrogant." It is said that by this system a broadside may be trained and fired without the presence of a gunner, the entire mechanism being operated from the conning tower.

It is beginning to be realized that forced draft is quite a necessity in the smaller sizes of direct-current motors. In the alternating-current motors it has been the practice to use artificial ventilation, even in the small sizes; but in the direct-current motors with their solid armatures, it is even more necessary that some steps be taken to dissipate the heat generated. In Germany some of the electrical concerns are constructing their direct-current motors with artificial cooling systems.

A very convenient electrical stove has recently been devised, which is adapted to be placed on the table where breakfast dishes may be prepared and served hot. The stove is provided with a steel top, over which a wire grid may be placed so as to convert it into a toaster. When the grid is removed, the steel top may be used for cooking muffins, cakes, and the like, or the top may be inverted, forming a flat dish with a narrow marginal rim, which serves to retain fluids on the plate. The handle of the stove is arranged to serve as a pancake turner.

An ingenious burglar alarm, devised by a Dresden engineer, is described in a recent Consular Report. The apparatus consists of a curtain, which is drawn across the window or door, or around the safe that is to be protected. In the curtain are a large number of fine wires with small metal knobs, which connect the wire conductors at intervals. An electric current passes through the wires, and in case the curtain is disturbed in the slightest degree, the metal knobs are thrown out of contact with each other, thus actuating the burglar alarm. The curtain may also be used as a fire alarm in identically the same way.

Before this number issues from the press the Alaska-Yukon Pacific Exposition will have been opened by President Taft. The opening will be effected by the touch of a golden telegraph key in the White House, which will be connected by means of trans-continental lines with the Fair grounds at Seattle. The impulse which arrives from the White House will release a time device, whereby a large bell will be sounded to announce the opening of the Fair. At the same time two large whistles will proclaim the fact in the city. As soon as the bell ceases to sound, a flag 36 feet wide and 104 feet long will unfold at the rate of 10 feet per second, and at the end of each second a dynamite bomb will be exploded. In the mean time two photographs of the audience in the amphitheater of the Fair will be taken at an interval of fifteen seconds, by means of a relay which will automatically open the shutter of a camera.

Electric locomotives appear to be going through a process of evolution similar to that of steam locomotives. At first the motors of the electric locomotives were placed below the floor line. Now that large motors are being used, they are being placed above the floor, and connected to the driving wheels by means of driving rods similar to those of the steam locomotive. It used to be thought a low center of gravity was necessary for a steam locomotive, but it was found that the side blows tended to injure the track, whereas with a high center of gravity these blows were taken up by the springs, and converted into a downward pressure rather than a side pressure on the rails. The same principle applies to electrical motors. In a discussion of this subject in a recent number of the Electrical Journal, the following conclusion is reached: That the only part of the locomotive not completely spring-supported should be the wheels and axles and any connecting rods used in conjunction therewith; that the center of gravity of the machine should be raised to about one and one-tenth times the width of the gage; that all the heavier parts of the locomotive should be placed longitudinally within the length of the driving wheel base, so that no heavy masses will be at either end of the locomotive; and that the motors should be rigidly fastened to the main frame of the locomotive, where they would be much more accessible. They could be of a partly open type, thus allowing better ventilation. Possibly forced ventilation would be necessary.

SCIENCE.

Prince Henry, brother of the German Emperor, is the inventor of an automatic window washer. Lest it be supposed that the device is a household improvement, let it be stated that it is intended for the purpose of wiping off moisture from the glass wind-break of an automobile, so that the rider's vision may be clear at all times.

Word has been received from Dr. Charcot, in charge of the Pourquoi-Pas Antarctic expedition, that he reached Deception Island on December 22nd, 1908. Charcot hopes to establish his winter quarters on Alexander Land, the name given to the region lying to the south of Graham Land in about 70 degrees south latitude. Deception Island is a circular volcanic island, the crater of which forms a magnificent roadstead of great depth, which is entered by a narrow opening between two cliffs.

In an address delivered before the Manchester and Salford Sanitary Association, Mr. H. W. Norman stated that during the war in South Africa it was found necessary to send back 3,000 soldiers who were unable to bear the rigors of the campaign, solely on account of the condition of their teeth. They were not able to chew "bully" beef and hardtack. Teeth seem to have deteriorated, judging by a comparison of the dental apparatus of the modern young person with that of his ancestor's skull in anthropological museums.

As a result of the work of the National Physical Laboratories and International Electrotechnical Commission, it seems likely that an official international candle will eventually be adopted. Such a step will substitute for the various standards of luminous intensity which are used in the various countries of the world, and which vary from the English sperm-candle standard and pentane gas flame to the French colza-oil flame and the German amylacetate flame, a single standard which will enable illuminating engineers to talk intelligently about the same thing.

The compilation of the great map of the sky under the auspices of the Paris Observatory will be a colossal task. Seventeen observatories—those of Greenwich, Rome, Catania, Helsingfors, Potsdam, Oxford, Bordeaux, Toulouse, Algiers, San Fernando, Tacubaya, Santiago de Chile, Cordoba (Argentina), Perth, Capetown, Sydney, and Melbourne—have been at work in their respective spheres for the past twenty-two years charting the portion of the heavens under their observation, by means of photography. No fewer than 22,054 negatives have been taken, and over 2,000 of them have now been engraved on copper.

Alfred H. Harrison in an article recently published in the Nineteenth Century sets forth his belief in the success of any expedition which will simply drift across the North Pole. Calculations based on the drift of casks convince Mr. Harrison that he can float right across the center of the Arctic Ocean within easy reach of the Pole, and that he will finally emerge somewhere near Spitzbergen. He argues that an expedition when drifting can house itself in Eskimo huts, and that it can maintain itself by means of provisions safely *cached* on the ice. It is his idea to start at Pulen Island in October of this year or in 1910. Three years' supplies are to be placed on the ice.

A very curious application of the properties of calcium carbide has been made in Australia; namely, to the quick and easy determination of the quantity of water contained in wool, before shearing, an operation which is impracticable with very wet fleeces. A little wool is clipped off, weighed, and mixed thoroughly with an excess of calcium carbide, in a suitable apparatus. The acetylene produced by the reaction of the carbide with the water in the wool is determined by measuring its volume at constant pressure or its pressure at constant volume, by means of a scale so graduated as to give directly the proportion of water in the wool.

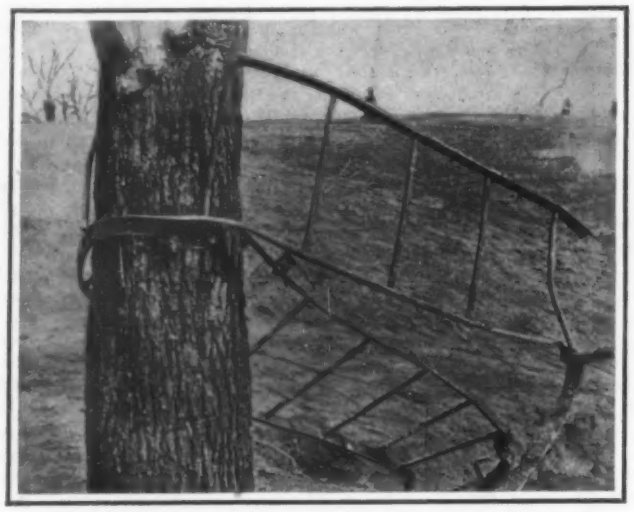
According to Nature, the Council of the Röntgen Society has decided to act upon the advice of the committee, appointed in 1906, to consider the possibility of preparing a standard for the measurement of radio-activity. This committee recommends that "The γ-ray ionization from 1 mg. of pure radium be regarded as a standard, and called a unit of radio-activity." Three sub-standards of $RaBr_2$ are to be prepared, and comparison will be made with a specimen of the purest $RaBr_2$ at the Victoria University, Manchester. The quantity of radium in other specimens will be capable of accurate measurement by comparison with the sub-standards. It is anticipated, therefore, that by this means the exact description of medical, physical, or other work with radium will be facilitated, and that the possibility of fraud in the sale of expensive radium preparations will be eliminated. The council proposes to lend the sub-standards to any competent person desiring to measure the amount of radium in his possession, or to arrange for authoritative tests to be made.

THE BURSTING OF A WATER TANK AND ITS EFFECT.

Two water tanks, each of one million gallons capacity, recently burst at Parkersburg, W. Va., within twenty seconds to one minute of each other, according to different observers. The tanks were about eleven feet apart, and it is probable that the bursting of the second was caused by the flying parts of the first. Although the two tanks held but two million gallons, nearly half the sidewalks of the town were flooded over an area of one-half mile wide and three-quarters of a mile long, the water between curbings reaching a depth of twelve to fourteen inches.

The tanks were sixty-five feet in diameter and forty feet in height, and were erected twenty-four years ago. The bottoms were made of ¾-inch plates, laid on a bed of mortar with a course of stone masonry about 2 feet wide around the circumference. The walls of the tanks were composed of ten course plates, each 4 feet wide and varying in thickness from ¾ inch at the bottom of the tank to 3/16 inch at the top. An examination made after the accident seems to prove that the walls of both tanks parted in nearly straight lines, perpendicular to their bottoms, and at points beginning a few feet from the base and extending more than half way to the top.

Of the effect of the bursting of the tanks and the rush of water, some idea may be gathered from the accompanying illustrations. A 45-foot iron ladder, which had been fastened to the side of one tank, was wrapped around the trunk of a tree. One of our pictures shows a wrecked house, which was actually occupied at the time of the accident. The collapsed tanks themselves after the accident looked very much like deflated balloons.



Forty-five-foot iron ladder wrapped around tree by the rush of water.

General Processes and Present Condition of Electrometallurgy.

The advantages presented by the employment of electrical methods of metallurgy have caused the production in recent years of many special metals and alloys by electrical methods and have suggested the application of electricity to the commoner metals. Some of the principal processes now or soon to be in use are the following:

Antimony. Borchers electrolyzes a solution of antimony in sodium sulphide, using anodes of lead. Siemens and Halske employ a solution of antimony sulphide in an alkaline sulphide. Gin, Izart and Thomas electrolyze the sulphoantimonite of sodium. Betts extracts antimony from residues of copper, refining by solution in hydrofluoric acid.

Bismuth. In Becker's process a solution of bismuth or its compounds in ferric sulphate or ferric chloride is subjected to electrolysis.

Vanadium. In 1893 Moissan obtained by the electric furnace ferro-vanadium containing 4 or 5 per cent carbon. Girod produces ferro-vanadium containing 25 or 50 per cent vanadium and 1 to 3 per cent carbon.

Beckett treats vanadium trioxide with silicon and carbon in the electric furnace. Gin electrolyzes ferrous fluoride dissolved in fused calcium fluoride, employing as an anode a mixture of carbon and vanadium trioxide. The cathode is a bath of iron. Ferro-vanadium is manufactured by Beckett at Niagara Falls and by four European companies.

Tantalum. Almost all the tantalum produced is manufactured by Siemens & Halske in Berlin. Girod has made a little ferro-tantalum by reducing tantalite in the electric furnace.

Carborundum, or Carbide of Silicon. The factory at Niagara Falls employs ten furnaces of 1,000 horse-power, with an electromotive force between 100 and 260 volts, and produces annually 1,500 tons of carborundum. A few tons are made annually in Savoy and there is a third factory in Bohemia. For the purpose of supplying the European market a large factory is being constructed in Germany, where the Acheson patent has been annulled.

Titanium is produced in the form of ferro-titanium and also in small quantities as carbide, silicide, and boride of titanium, which are extremely hard substances employed as abrasives and in cutting precious stones.

Sodium. The total production of electrolytic sodium is 1,200 tons in America and 200 tons in Europe annually. Various processes are employed in numerous factories.

Calcium. About 100 tons are annually produced.

Magnesium is made almost exclusively in one establishment near Bremen. The production does not exceed 300 tons per year.

Zinc. Many attempts have been made to produce zinc both in the wet and dry way by electrical methods. The most interesting of the wet processes is that of Houpfner, which produces zinc 99.9 per cent pure and is in operation at Wilmington near Chester.

At present only two factories are using the dry processes, the Canada Zinc Company of Vancouver and a factory in Europe. The electro-metallurgy of zinc appears destined to have a grand future.

Aluminium. Numerous processes have been devised. The price of the metal has been greatly decreased and the market is likely to become glutted if new uses are not found. In France 140,000 horse-power will soon be employed in the manufacture of aluminium, the annual production being 20,000 tons. The Swiss factories have a capacity of 1,000 tons per year, and this will soon be increased to 6,000 tons. Aluminium is also produced in constantly increasing quantities in England, Germany, Austria, Italy, and the United States. The European annual production will soon amount to

Side of one of the tanks which was found over 100 feet from its foundation.

Remnants of the Lutheran church of Parkersburg after the accident.

These two houses were carried one block away from their foundations. Two of the occupants perished; five escaped.

Lutheran church carried one block. Organ parts were found five blocks away.

THE BURSTING OF A WATER TANK AND ITS EFFECT.

30,000 tons, to which America will be able to add 15,000 tons. In 1909 the capital invested in this industry will certainly exceed $30,000,000. The price of the metal has fallen below 18 cents per pound.

A NOVEL FRENCH AEROPLANE.

The peculiar aeroplane illustrated on this page is that of M. Givaudan. It has recently been constructed at Vermorel. It is of the multicellular type, and consists of two concentric drums mounted near the ends of a body framework that passes through the center of each, and carries at its forward end a tractor screw. These drums are united by small planes spaced uniformly apart, thus forming a cellular structure. The front cell thus formed is movable in every direction, while the rear one is stationary. The carrying surfaces of this machine are so formed, that the machine will have the same amount of supporting surface whatever its lateral inclination may be, so that when it tips to one side in making a turn, or from any other cause, the weight carried per square foot of surface remains the same; while, on the other hand, the center of gravity being situated below the center of pressure, the machine will return automatically to its normal position and be in equilibrium. The two cells are placed sufficiently far enough apart, so that the front one will not interfere seriously with the one at the rear. There are no rudders, the movement of the front cell both sideways and up and down being used in place of these to direct the machine both laterally and in a vertical plane.

The radiating planes of the drums act as carrying and stabilizing surfaces. Only the projecting surface of these radiating planes is counted upon as useful carrying surface. Within both the front and rear drums there is a horizontal cross shaft supported upon the main frame. The front cell rests on the main frame by a bearing, which makes it possible for this cell to oscillate about a vertical axis, while the horizontal shaft just mentioned can oscillate upon a horizontal axis.

The Givaudan circular aeroplane—a new French machine of novel design.

Inclination of the front cell in a vertical direction varies the angle of incidence, and causes the machine to rise or descend; it thus takes the place of the horizontal rudder. Inclination of the cell in the horizontal direction fulfills the rôle of the vertical rudder. This double movement of the cell is obtained by means of a rod connecting two levers of sufficient length to make the operation of the cell possible without too great fatigue. The levers have a band-brake arrangement to hold the cell in the position in which it is set.

The machine rests on four wheels, the front pair of which can be turned in order to steer the machine. The wheels are fitted with suitable springs to absorb the shock when landing. The propeller is 2.4 meters (7.87 feet) in diameter, and is driven from the motor through reduction gears. The motor is a special eight-cylinder V engine of the air-cooled type. The bore and stroke are 90 and 120 millimeters (3.6 and 4.8 inches) respectively. The motor develops 40 horsepower and weighs 80 kilogrammes (176 pounds) including the fly-wheel, two carbureters, and magneto. All the valves are mechanically operated from a single camshaft. This motor, notwithstanding its light weight and the fact that it is air-cooled, has been run several hours consecutively. M. Givaudan is one of the first men to construct a motor of the V type and place it upon the market.

This new aeroplane is very interesting, but it is doubtful whether a freakish machine of this kind can be made to operate satisfactorily. If any successful trials are made, we shall be glad to apprise our readers of the fact.

SOME NEW AMERICAN AEROPLANES.

Recent activity by members of the Aeronautic Society has resulted in the production of several new aeroplanes at Morris Park, one or two of which have already been given their first trials. At the present time there are completed or under construction upon the society's grounds, a monoplane, four biplanes, and one triplane, as well as a new helicopter.

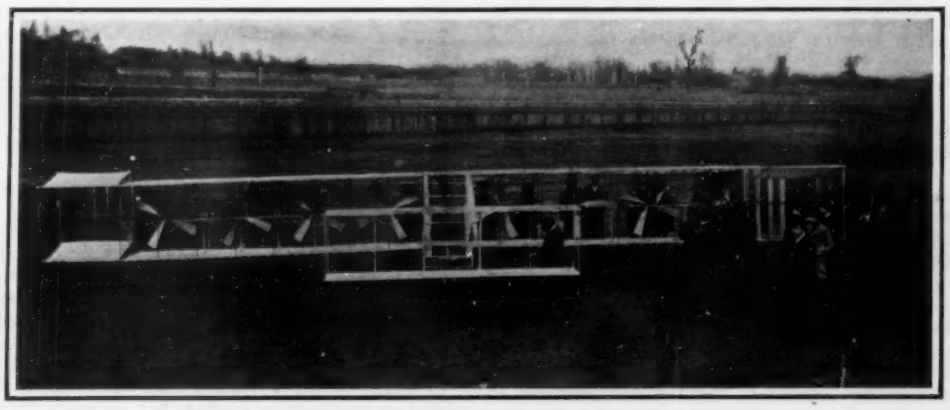
One of the novel machines now completed, and which has already undergone several tests, is the triplane of Morris Bokor. This machine is shown in one of our illustrations. Its three planes have a spread of 26 feet and a width of 6½ feet, making a total surface of 507 square feet. A 14 x 2½ foot horizontal rudder has 70 square feet additional supporting surface, while the tail, consisting of two pairs of surfaces at a sharp dihedral angle, is 14 feet long and has 72 square feet. The total weight of the machine, with water, oil, and gasoline, and with Mr. Bokor on board is 1,181 pounds, so that the usual ratio of weight to supporting surface —2 pounds to the square foot—is closely adhered to. The upper and lower planes are 6 and 5 feet above and below the middle plane respectively. The inventor's theory as to why less space between the lower and middle planes can be used than is required between the middle and upper one is that the draft of the propellers will draw the air back below the middle plane, and thus tend to check or neutralize the interference of the lower plane. The two propellers, which are driven in opposite directions by chains from the motor, are 8 feet in diameter, with an 11-foot pitch. They are made of wood and have quite narrow blades, covered partly with cloth. The propellers make one revolution to 3½ of the motor. They gave 248 pounds thrust at 500 R. P. M. with the machine held stationary. The motor used is a four-cylinder, 4 x 4-inch, A and B four-cycle automobile motor. The inventor claims 38 horse-power for it at 1,800 R. P. M., but this figure is probably somewhat high. The motor alone weighs 310 pounds, but with all accessories including a 15-pound magneto, a 30-pound Livingston radiator, 30 pounds of water, and 34 pounds of fuel and fuel tank, the weight is 419 pounds.

The main feature of the Bokor aeroplane is the use of a pendulum seat for the aviator, which is connected by cables to the ends of the lower plane at the rear. The outer rear parts of this plane are supported upon flexible trusses running along it, and which are in turn carried upon hinged rods extending back from the vertical uprights at the ends of the planes.

When the machine tips to one side or the other the aviator's seat remains horizontal and exerts a pull upon the flexible rear edges of the lower plane, thus giving it the proper inclination to cause the machine to right itself again. Another feature of this aeroplane is the tail, consisting of two large tetrahedral-like cells, which should aid in giving the machine stability. Since the photograph reproduced herewith was taken, the inventor has mounted his aeroplane upon skids. In starting, the whole machine is placed upon a four-wheeled chassis, to enable it to run along upon the ground. This chassis is left behind when the machine rises. In all probability, however, a larger engine will have to be installed before the triplane can be made to soar.

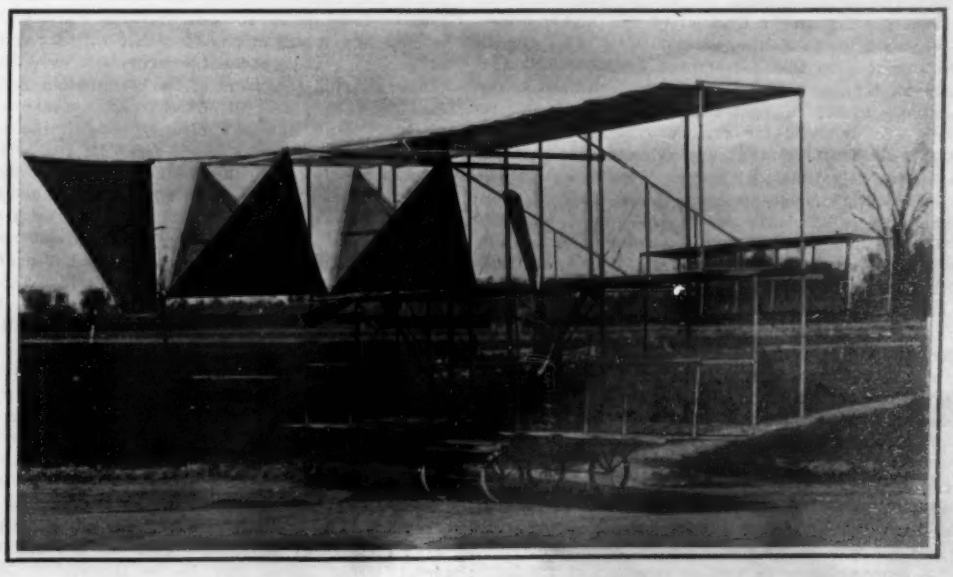
The other American aeroplane which we illustrate is that of Mr. Wilbur M. Kimball, the secretary of the Aeronautic Society. Mr. Kimball, it will be remembered, last fall built a helicopter consisting of a large number of small propellers. In constructing his bi-

(*Continued on page 431.*)



Front view of the Kimball biplane.

The notable features of this machine are the multiple propellers and rudders between the planes at the rear of the wing tips.



Three-quarter rear view of the Bokor triplane.

The double V-shaped tail and swinging aviator's seat (which warps the lower plane) are this machines main features.

NEW FRENCH AND AMERICAN AEROPLANES.

The Progress of the Metallic Filament Lamp.

BY HERBERT T. WADE.

The recent development of high-efficiency electric incandescent lamps and their manufacture on a large scale has had an important bearing on electric lighting and on illumination problems generally, for the simple reason that these new lamps enable three times as much light to be obtained with the same amount of current. The practical result is that they seem destined to supersede both the open and inclosed arc for interior lighting as well as for certain forms of street lighting, while the quality of the light, on account of its close resemblance to daylight, makes these lamps most useful and valuable where color considerations are important, as in matching shades. The superiority and economy of these recent lamps can best be understood by comparison with the older types. Of these the carbon filament incandescent lamp has been used generally for a quarter of a century with but few improvements in its efficiency or economy, notwithstanding the fact that apparatus and methods for its manufacture have been so perfected that the cost has been enormously reduced; so that to-day, aside from first cost, the carbon filament lamp is undeniably an expensive form of illumination. The efficiency of such a lamp ranges from 3.5 to 3.1 watts per candle, the practice being to rate these lamps according to the number of watts required to produce illumination equal to one candle-power. Now the watt or unit of power is the power produced by an electric current of one ampere per second under a pressure or difference of potential of one volt, and the kilowatt, or 1,000 watts, in the form of a kilowatt-hour is the usual basis for the sale of current. For example, on a 110-volt direct current circuit a 16-candle-power lamp requires approximately 0.5 ampere, so that the power consumed by the lamp is 55 watts or 3.4 watts per candle.

Now the light emitted by an incandescent body depends upon its temperature, and this of course in the case of a lamp filament depends upon the current, so that to make it glow more brightly the voltage must be increased. But carbon, unlike the metals, has a negative temperature coefficient and its resistance decreases as its temperature rises, and a greater current flows through the lamp with a correspondingly increased expense for power consumed. Furthermore, above a certain temperature the carbon filament begins rapidly to disintegrate and to become volatilized. The reasons underlying the lack of efficiency of the ordinary carbon filament have long been realized, but it has been only in the last five years that satisfactory progress has been made toward securing materials of sufficient resistance and strength to supplant it. First came the metallized filament where the carbon loop, after it had been formed, was subjected to the heat of the electric furnace and was made much more refractory and durable, its resistance being increased so that it could withstand a much higher temperature. In this way there was evolved a lamp which was rated at 2.5 watts per candle, and a regular type of lamp was put on the market, which, consuming 50 watts, could work at from 90 to 130 volts, and furnish 19 to 20 candle-power of illumination. In this lamp there was a saving of 20 per cent in current over an ordinary carbon filament lamp of the same candle-power. Then came the tantalum lamp with an efficiency of 2 watts per candle, where a long wire of tantalum was supported within an exhausted globe, and when incandescent diffused a brilliant and white light.

But this was by no means the end, for the tungsten lamp was produced with an efficiency of 1¼ watts per candle by using a filament of this highly refractory metal whose melting point is about 3,050 deg. C. Here is a lamp that gives three times the illumination for the same amount of current consumed as the ordinary carbon filament lamp, and while better results are promised for various experimental lamps, this to-day represents the maximum efficiency for commercial incandescent lamps. Now these high efficiency metallic filament lamps, being made of materials more difficult to obtain and work, naturally command higher prices than the ordinary carbon filament lamps where cellulose from cotton is transformed into carbon. But their efficiency is so great that they pay for themselves in a comparatively short time, and accordingly have been installed in the new large office buildings in New York city. Furthermore, since they are made in large sizes they are able to supplant the arc lamp with a gain in economy as well as in producing a light of much more pleasing quality without flickering or noise, and without the dirt and inconvenience incidental to trimming. As a result, in stores, large auditoriums and public places, as well as in residences, hotels, and theaters, they can be used advantageously.

So much in successful illumination depends upon the proper placing as well as selection of the lamps in accordance with the principles of the modern science of illuminating engineering, that in planning new installations of these high-efficiency lamps particular attention is being paid to their proper arrangement and the use of suitable reflectors and shades. The results already achieved seem to indicate that substantial progress has been made in raising the standard of illumination, and make of interest a few of the fundamental considerations. In illuminating engineering the basis is the candle-power or light emitted by a standard candle prepared according to specifications and burning in a specified way. In speaking ordinarily of candle-power in the case of an incandescent lamp is meant the mean horizontal candle-power or intensity of light emitted at right angles to its axis when the lamp is vertical. This, of course, is different from the intensity measured in some other direction, as under the tip or around the socket, where naturally little or no light is emitted. Now for each lamp a diagram showing the spherical distribution of candle-power is computed and then various forms of reflectors and shades are added and their effects ascertained, as it is desirable to intercept and reflect most, if not all, of the light sent out by the lamp above the horizontal plane and bring it down to tables or elsewhere below, where it will be of service. In this way, by using a reflector of proper shape instead of having light pass up and be reflected from ceiling and walls, it can be evenly distributed below the lamp so that there will be an increase in intensity even over the mean horizontal candle-power by which the lamp is rated.

Uniformity of illumination is the chief end of successful lighting, and if the engineer knows the intensity and distribution of a given unit of lamp and reflector he can calculate the number required and their distribution to afford any desired degree of illumination to the apartment. The standard for measuring the intensity of illumination on a surface is the foot candle and is the amount of illumination supplied by a standard candle at a distance of one foot. As the intensity of light varies inversely as the square of the distance, a 16-candle-power lamp at a distance of 4 feet from a surface would give one foot candle or one-sixteenth the illumination that it would afford at a distance of 1 foot, where the intensity would be 16 foot-candles. The number of foot-candles required depends upon the purpose for which the room is to be used. For a passage hall or a reception room needing only a fair amount of illumination ½ foot-candle will suffice, but for reading at least one foot-candle, and better two, are required; while for store lighting, where articles must be examined in a strong light and as much illumination as possible is desirable, four or more foot-candles can be used. The degree of intensity must be considered with reference to some working plane at a distance above the floor depending of course upon the purpose of the room. Thus, for a store the level of the counters could be taken for this purpose, while for an office the height of the desks would serve. In all illumination the lamps must always be kept out of the line of direct vision, as not only is the glare unpleasant, but the observer's attention is directed to the lamps themselves, and this while always unpleasant is a fatal defect in show-window illumination, where the object is to concentrate the attention of a future purchaser on the goods exhibited, and show them as effectively as possible.

The most satisfactory arrangement of lights for almost any size of room is to group them symmetrically at or near the ceiling, and by knowing the foot-candles per square foot of area a given lamp will give, select and so place the units that the distribution will be uniform. This can be tested by taking a series of stations at various points in the working plane, and then computing the intensity of illumination in foot-candles at each of these stations. For each style and size of lamp together with its systems of reflectors and shades the manufacturers prepare tables showing the value of its illumination in foot-candles when placed at different heights above the working plane, not only directly beneath the lamp, but at various distances from a point directly beneath. In this way can be found the number of foot-candles that each lamp produces at a single station, and then taking the sum of these effects, the total illumination at that point is obtained. As these stations should be well distributed about a room, a good idea of the distribution of the illumination is afforded, and it can be ascertained whether the uniformity and intensity meet the requirements. Reflection from wall and ceiling also plays its part in illumination considerations, but this differs greatly with their color and material, so that the general effect is to increase the available light in the lower part of the room and more evenly to diffuse it. So much depends upon the successful treatment of illumination problems, that the manufacturers of the new high-efficiency electric lamps and the lighting companies are anxious that they should be used as effectively as possible in order that their many advantages over the arc and older incandescent lamps may be as thoroughly demonstrated as their economy. If proper attention is given to the placing of the lamps and the installation of the best units, much better illumination can be secured under all conditions with a considerable economy.

The Tachypod.

The tachypod is a new instrument of locomotion invented by Petrini, a tutor in the University of Upsala, Sweden. It is a sort of roller skate, with two large wheels resembling those of a bicycle. The wheels are attached to the lower ends of two arms which are movable about the joint which connects their upper ends, so that the arms can open and shut like the blades of a pair of shears. Above the joint is a plate or shoe on which the foot of the operator rests and which is fastened to the ankle by a brace. When the weight of the body is allowed to press on the shoe the wheels and the arms separate and unwind a wire cable which is wound on a reel carried by the axle of the rear wheel and fastened by one end to the axle of the front wheel. When the pressure is removed, by shifting the weight of the body to the other foot, the wheels are brought together and the cable is wound up by a spring. The reel is so mounted on the axle that it runs loose when the cable is wound up, but engages with a pawl and turns the axle when the cable is unwound; that is, when the wheels are forced asunder by the weight of the body. Hence the rear wheel acts as a driving wheel, the source of energy being the weight of the body; and as the weight is shifted alternately to the right and the left foot, in the ordinary motion of walking, one or the other driver is continually in operation and the wearer is impelled forward with considerable and nearly uniform velocity. The inventor has attained a speed about equal to that of a good bicyclist.

Effect of Sunlight on Wireless Signals.

In 1902 Marconi found the radius of action of a wireless sending station to be three times greater at night than in daylight and attributed this difference to the action of sunlight in dissipating the negative charge of the sending antenna. A different explanation was given by J. E. Taylor. The experiments of J. J. Thomson proved that electric waves are strongly absorbed in traversing space containing free electrons. The sun continually emits electrons which ionize the air exposed to sunlight. Hence the difference in the effective radius, by day and night, would appear to be due to the greater absorption of the waves by day, resulting from the increased ionization of the air between the two stations. Recent experiments by Mosler prove that the emission is not affected by sunlight and that absorption, increasing with the distance, must take place between the two stations. Zenneck has shown, however, that ionization, and consequently absorption, are very small in the lowest stratum of the atmosphere. Hence it appears plausible to assume that electric waves passing between distant stations traverse atmospheric strata of considerable height. This assumption is supported by the recently published theoretical conclusions of Zenneck, according to which electric waves are chiefly radiated, not parallel to the earth's surface, but obliquely upward. Hence the greater part of the path of the waves passing between two very distant stations must traverse high atmospheric strata which are strongly ionized by solar radiation.

The Current Supplement.

The opening article of the current SUPPLEMENT, No. 1744, discusses the Davidson "Gyropter" flying machine, which is a form of helicopter. Prof. Carl C. Thomas writes on Some Recent Advances in Mechanical Engineering, and points out the progress which has been made in prime movers, such as gas engines and steam engines, with particular reference to blast-furnace gas. W. R. Beattie's excellent monograph on the Repair of Farm Equipment is concluded. H. Quentin writes on the "Omnicolor" Plate for Color Photography. The Production of Sulphate of Ammonia from Peat is described in detail by the English correspondent of the SCIENTIFIC AMERICAN. A person attacked by diseases of microbial origin becomes immune to that disease for a longer or shorter period, and often for life. Why? The answer will be found in an article entitled "The Mechanism of Immunity." J. G. Gore, the well-known astronomer, contributes an article on Some Astronomical Curiosities. The Electrolytic Preparation of Lead Compounds is discussed by Carl Duvivier. The usual engineering notes, science notes, and trade notes will also be found in the SUPPLEMENT.

Petraliter is an explosive invented by Söjberg in Stockholm. The composition is as follows: 60 parts nitrocetyl (from spermaceti), 60 parts nitrocetyl (from Chinese wax), 60 parts nitroglycerine (these three substances in variable proportions to each other according to the effect the explosive is desired to produce), 16 parts potassium (sodium or ammonium) nitrate, 1 part palmatinate of cetyl (purified spermaceti), 1 part carbonate of lime, 6 parts nitrocellulose, 16 parts prepared wood charcoal.

Correspondence.

SIGNALING TO MARS.

To the Editor of the SCIENTIFIC AMERICAN:

Among the suggestions that are being made as to the proper method that should be used in the attempt to signal the Martians, there seems to be a wide difference of opinion upon a point which really admits of no debate. For instance, in your last number (May 15th) you tell of a "practical heliograph man," who comes forward with the astounding statement (which was said to be "overlooked") that a mirror two inches square will reflect just as much light as one ten feet square. Comment upon the importance of this discovery would be superfluous. We may rest assured that Prof. Pickering is not mistaken in what he says are the optical requirements of the experiment. The "practical heliograph man" seems to have confused the function of the mirror with that of the eye. A mirror simply reflects waves of light, the large mirror receives and reflects more light than the small one, a fact which admits of no debate; therefore, a mirror ten feet square is the same as three thousand and six hundred each two inches square.

However, all of the schemes suggested which involve the use of surfaces which reflect or absorb sunlight seem rather lame in view of the fact that the only time when they can be effectively used is when Mars is five times farther away than when nearest. Also, if a perfect reflector is used, it could only make a spot about three times as bright as the atmosphere, and perhaps not much brighter than the brightest clouds appear to an extra-terrestrial observer. Or, on the other hand, if a surface were used which would absorb all of the light which filters through the atmosphere, it would be seen through a medium (the atmosphere) which reflects about one-third of the total light that it receives, so the contrast would not be very great.

If a huge battery of powerful electric searchlights were directed toward Mars next September, and "winked" or turned on at critical moments, moments which rational minds could not fail to see the significance of, we might reasonably expect a response if we are ever to receive any at all. What is meant by critical moments are moments at which something of astronomical importance is happening, such as the conjunctions of the satellites of Mars with the sun, or their conjunctions with each other, or their moment of quadrature, or opposition, or similar moments in the motion of our satellite. If such signals were perceived, they would be responded to at similar moments, which would establish instantly the existence and intelligence of the inhabitants.

The "canals" of Mars may be "artificial," and yet not more so than the achievements of those creatures which we are accustomed to regard as belonging to a comparatively low order in the scale of being. It is quite within the range of the apparent fortuitous course of nature, that the type of life which has reached the zenith of development and become, morally and physically, the dominating factor upon our little neighbor, is closely allied, intellectually at least, to the creatures that manufacture in our fields and forests structures that are marvels of geometrical ingenuity. May not this type of consciousness, which we are pleased to classify as instinct, be responsible for what is observed upon Mars? WILFRID GRIFFIN.

Pittsfield, Mass.

THE SPEED OF THE "MAURETANIA."

To the Editor of the SCIENTIFIC AMERICAN:

In your Engineering Notes of April 3rd you say: "It begins to look as though the predictions of her captain that the 'Mauretania' will shortly cross the Atlantic at an average speed of 26 knots will be fulfilled."

How persistently these old traditions cling! Is it in order to speculate upon the day when the man in charge will be the man whose ingenuity has brought these floating engineering triumphs to their present state of perfection? At present the master is one whose advice is hardly sought, from the designing, from the laying of the keel, to the painting of the loadline. Seamanship is no longer the predominating qualification, but instead, a keen mechanical perception of the possibilities of steel and iron. The eyes of the world are centered, not upon the course the vessel takes, but upon the superb mass of machinery that drives her upon this course; and yet the captain is the proud possessor of the gold watch and testimonial presented for a record passage.

In these modern marine conveyances the engineering element is everywhere in evidence, from the propelling power to the compass that guides them on their way, and to the pantry heaters that warm the coffee.

Decades ago the tiller was reversed, but still the master orders "starboard" when he wants port, and "port" when he wants starboard.

Again the old tradition remains.

Victoria, B. C., Canada. JOHN W. E. LAKER.

[The contract for the "Mauretania" called for a sea speed of 24½ knots and a trial speed of 25¼ knots. For nine consecutive trips the ship has averaged over 25 knots. Her captain would be the last to take the entire credit to himself for this high speed. A record passage is the result of many favorable circumstances. First, there must be a properly-designed ship with ample power in her engine room. Given this, and the question of her time of passage is one of engine room and navigating bridge efficiency, and of favorable wind and weather.—ED.]

Eiffel's Experiments on Air Resistance.

Many experiments on the resistance opposed by the atmosphere to moving bodies have been made since Newton enunciated the formula $R = K S V^2$ for surfaces normal to the direction of motion. In this formula R denotes the resistance, S the area, and V the velocity. K is a coefficient which should be constant if the formula were rigorously correct but which has been found to vary greatly with the form and dimensions of the body. It varies also with the velocity, except for velocities less than 20 meters (65 feet) per second, for which it is sensibly constant. The resistance at velocities between 20 and 40 meters per second (45 and 90 miles per hour) is especially interesting because these are the velocities of swift vehicles, both terrestrial and aerial, and of destructive winds. The discrepancies between the measurements hitherto made are due to the complexity of the problem and the neglect of various elements, notably the separate effects of air filaments which differ at different points of the surface. Another source of error is the cyclonic motion of the air developed when great velocities are produced by means of a revolving aerodrome. These considerations explain why the values of K deduced from experiments vary from 0.07 to 0.12 (on the metric system), the highest values corresponding to the greatest areas and velocities.

Eiffel has endeavored to eliminate these errors in his experiments on the free fall of a long, heavy body which was constrained to remain vertical and to oppose to the air a level surface of simple form. The height of fall was about 312 feet and the body was guided by a vertical wire cable threaded lengthwise through the body. The pressure surface was attached to the falling body by springs, the compression of which was recorded on a blackened cylinder. The results were reduced to a barometric height of 30 inches and a temperature of 59 deg. F. For velocities between 18 and 40 meters per second the resistance of the air was found very approximately proportional to the square of the velocity, the exponent of V, however, appearing to increase slightly with the velocity, passing through the value 2 at the velocity of 33 meters (109 feet) per second. The coefficient K, after reduction to mean atmospheric pressure and temperature, was always between 0.07 and 0.08.

The Scientific American and a Certain Religious Picture.

A religious canvas has been exhibited throughout the country which is of so miraculous a character that, according to its owners, it completely baffled "a commission of scientists and chemists appointed by the SCIENTIFIC AMERICAN of New York, and the government chemists of Washington, D. C.," to quote the Los Angeles Express. The Editor of the SCIENTIFIC AMERICAN never saw the picture in question, nor did the SCIENTIFIC AMERICAN ever appoint a commission to examine it.

The picture is religious in subject. In it Christ plays a prominent part. According to the printed matter circulated by the exhibitors, "The figure of Christ appears as if walking in the pale moonlight. . . . Above and behind the figure is a dark cross." There is nothing mysterious about the picture. It has undoubtedly been painted with luminous paints.

We have received so many letters of inquiry from subscribers who state that the SCIENTIFIC AMERICAN is made to appear as having indorsed this picture, that we take this opportunity of denying any of the statements attributed to us.

Prof. David Todd's Plan of Receiving Martian Messages.

Prof. David Todd of Amherst College has given out reports of his proposed attempt to rise above the earth atmosphere for a distance of ten miles or more, and equipped with sensitive receivers to catch Hertzian wave signals which may possibly be sent forth from Mars. Naturally, Prof. Todd is compelled to provide some means of sustaining himself and his companion, Mr. Leo Stevens, in the extremely tenuous atmosphere of the upper regions. According to his plan, two cylindrical tanks will be carried up, each about four feet high and from two to three feet in diameter, and capable of holding a single person. The cylinders will be entered by a manhole at the top, fitted from the inside with a screw cover. The bottom of each cylinder will be of clear thick glass. Three or four windows will be provided around the sides. Within the tank will be a small rotary air pump for supplying oxygen from the outside, to take the place of that which has been depleted.

The plan seems to us fraught with much danger and uncertainty. Assuming that signals are actually received, how is it possible for anyone to be certain that they are really sent by our planetary neighbor? All told, there are about 2,000 wireless stations scattered over the earth, each radiating electrical energy into space. Is it not conceivable that Prof. Todd's instruments may respond to the impulses sent out by one or more of these stations? Even granting that these impulses will be the dots and dashes of the Morse code, and therefore clearly of terrestrial origin, is there any certainty that other apparent signals which cannot be so easily traced to their source have really emanated from Mars? The atmosphere carries a charge of static electricity which probably fluctuates in quantity and may excite a receiver. Furthermore, why should it be necessary to carry up an equipment of tanks? Would not a simple helmet fed from an oxygen tank answer? Dr. Berson of the Berliner Verein fuer Luftschiffahrt reached an altitude of 34,000 feet with a simple apparatus of this kind.

Lastly there remains the objection that only with great difficulty have self-recording instruments been made light enough to be carried up by *ballons-sondes* inflated with hydrogen gas. Is it likely that a balloon of the magnitude planned by Prof. Todd will be able to carry aloft two men, the necessary amount of ballast, and two cylindrical tanks, pumps, instruments, and other scientific equipment to the height contemplated?

To Prevent Bubbles in Iron Castings.

Bubbles in iron castings are caused by evolution of carbon monoxide and other gases in the process of cooling and solidification. The formation of bubbles, which greatly diminish the strength of the casting, can be prevented by the addition of certain metals and alloys, which absorb oxygen and facilitate the elimination of other gases by raising the temperature of the molten iron, making it more fluid and producing more or less agitation in the mass. Ferro-manganese and ferro-silicon, which were first employed for this purpose, make the grain of the casting much finer and increase its strength by 15 per cent.

But pure and easily oxidizable metals, such as aluminium, magnesium, or sodium, are far more effective and they do not, like the alloys above mentioned, affect the general quality of the casting. Aluminium is especially suitable for very hard iron containing little silicon. An addition of 1/50 to 1/20 per cent of aluminium suffices to prevent the formation of bubbles. Magnesium has been used for several years in casting copper and copper-nickel alloys. It is now being employed in iron and steel foundries, in the form of an alloy with iron or with aluminium and in the proportion of 1/20 per cent of the weight of the casting. Sodium has not yet been employed in practice. Calcium not only absorbs oxygen but eliminates dissolved hydrogen. It combines with the carbon of the iron to form calcium carbide, which is decomposed by the hydrogen. Thus the calcium is again set free and the hydrogen is converted into acetylene, which rises and burns at the surface. Experiments have recently been made with ferro-vanadium containing a large proportion of carbon and consequently unsuitable for the manufacture of special steels.

A Crisis in Swiss Watchmaking.

An investigation made recently by the Swiss government shows that the watchmaking industry of Switzerland is passing through a severe crisis, which affects no less than 70,000 persons. The workmen who have been able to retain their employment have been compelled to consent to great reductions in wages. Skilled workers, who were receiving from $10 to $15 a week, are now paid only $6. The chief cause of the depression is to be sought in foreign competition, as France, Germany, and the United States have successfully undertaken the manufacture of cheap watches, in silver, nickel, and steel cases. The Swiss manufacturers of chronometers and fine watches do not appear to feel the depression as severely as the makers of cheap watches.

Roman letters of various sizes are commonly employed by oculists in testing acuteness of vision. Recent experiments by Guillery show great differences in the ease with which the different letters are recognized by the same person. T is especially difficult of recognition, and is apt to be mistaken for Y. By a similar optical illusion the angle of L is rounded off, making the letter resemble a reversed J. V is the easiest of all letters to recognize and O presents little difficulty. K is more easily recognized than H, which resembles it closely, and both N and Z are easily recognized. A is easily guessed at from its general form, but is difficult of positive recognition, including distinct perception of the horizontal line. E and F are among the most difficult of all the letters.

AURORAS: SOME RECENT THEORIES.

It has long been known that the compass needle, which usually points northward and is inclined at an angle to the horizon (its dip), is disturbed and oscillates when an aurora is seen in the sky. This common effect led the celebrated Halley in 1714 to hazard the conjecture that the aurora is a magnetic phenomenon. The last few years have seen the equipment of expeditions to Iceland, Finland, and northern America for the principal object of observing the earth's magnetic disturbances. There are two theories on the subject, one due to Prof. Birkeland of Christiania, and the other to Prof. Svante Arrhenius of Stockholm.

It has long been known that violet light rays and the invisible rays of the spectrum beyond the violet, which can be detected by photography, have the property of discharging a negatively electrified body. It is suggested by Prof. Birkeland that the spots on the sun are caused by solar eruptions, or to use a familiar word, volcanoes; and that the sun then emits negatively-charged corpuscles similar to those which are believed to constitute, partly at least, the cathode rays—rays producing those utilized for surgical practice in taking photographs of bones. Prof. Birkeland supposes that such corpuscles are "sucked" into the earth's magnetic poles, giving rise to vortices of electric currents in the upper regions of the atmosphere. It is indeed known that such rays are deviated by a magnet; and also that the presence of large solar spots is always accompanied by magnetic "storms" on the earth and the appearance of frequent and brilliant auroras.

Arrhenius believes that the corpuscles emitted by the sun are not inconceivably minute bodies, but that they have an appreciable size; that they are, let us say, the thousandth of a millimeter, or one twenty-five-thousandth of an inch, in diameter, and that they are expelled from the sun by the repulsive action of light. That light is thus capable of thrusting particles out into space despite the enormous pull of solar gravitation is now conceded. Profs. Nichols and Hull have experimentally proved that light does exert pressure, so that there is nothing inconsistent with Arrhenius's supposition.

Whether Birkeland or Arrhenius is right, it is likely that negatively electrified gaseous molecules are present in the upper regions of the atmosphere, and it is also likely that these molecules receive their charge most readily where they are most exposed to a vertical sun—that is, at or near the equator. Upper aerial currents, according to Prof. James Thomson, would carry these and other molecules toward the poles. They would move spirally northward and southward with an easterly trend. As they approach the poles their number per unit area will obviously increase; for the terrestrial parallels of latitude decrease in circumference the nearer they are to the poles. It is to be expected that before the actual poles are reached, the potential of the upper air should increase to such an extent as to produce a luminous discharge, in the form of a ring or halo, with the magnetic poles as their centers. It is conceivably this ring which we see as an arch in the sky.

Prof. Paulsen divides auroras into two classes. Those of the first class are widely extended, quite steady, and show no streamers. In general, they rise slowly toward the zenith and do not affect the magnetic needle. An aurora of this type usually appears in the form of an arch, or a number of arches. Extended regions of the Arctic and Antarctic sky often glow with a faint light like translucent clouds. Sometimes these luminous masses are so near the ground that they appear in front of hills not more than 1,000 feet high. In northern Finland Paulsen observed the characteristic line of auroras in the spectrum of the light emitted by the air between a spectroscope and a black cloth a few yards distant.

Auroras of the second class are distinguished by characteristic streamers or rays, either sharply separated or blending at the bottom and presenting the appearance of curtains flapping in the wind. The rays are nearly parallel with the dipping needle and when seen in perspective appear to diverge from the center of a radially-striped corona. Auroras of this class are not steady, but are traversed by series of luminous waves. As they rise from the northern horizon, they deflect the needle of the compass to the east, but after passing the zenith they cause a westward deviation. Hence, Paulsen infers that these streamers are only rays in which negative electricity moves downward. Auroras of the first class are more akin to phosphorescence, involving little movement, but the two types often quickly succeed each other.

That there is some connection between auroras and the sun is indicated by the fact that the radiate auroras closely follow the eleven-year sun-spot period. The coronal streamers of an aurora seem to have small velocity in years of minimum spot frequency, and very high velocity in years of maximum activity. Besides the eleven-year period, several others can be traced in auroral phenomena. There is an annual periodicity which Arrhenius explains by his solar dust theory. A period of 26 days seems to affect auroras, terrestrial magnetism, and thunder storms. It has long been ascribed to the sun's rotation. A daily period and one equal to a tropical month (27.3 days) have also been traced, but are difficult of observation.

Antarctic auroral streamers.

Antarctic auroral arc and curtain above, July 5th, 1902, 0 h. 30 m. A. M.

FORMS OF THE AURORA AUSTRALIS.

When the spectroscope is turned on an aurora, a green light is noted. Many other lines have been photographed, but this line is extraordinarily intense, and, indeed, can often be seen when there is no visible aurora, by simply directing a pocket spectroscope toward the north. When first observed, the line was not known to be characteristic of the spectrum of any element. In 1898 Sir William Ramsay announced the discovery of three new ingredients of the atmosphere, to which the names neon, krypton, and xenon were given. The spectrum of neon is characterized by many red, orange, and yellow lines, while that of xenon shows many green and blue lines. The light evolved from tubes containing these gases under low pressure when an electric current of high tension is passed through them is of a corresponding hue. Thus, neon sends out a blended rose or flame-colored light; xenon a sky-blue, while the light of krypton is naturally white, although seen by some people as pale lilac, and by others of a pale green color.

When the wave lengths of the more important lines of krypton were measured, one was found, a very brilliant green line, which had a wave length of 5,570.5. The green line of the aurora to which reference has already been made has a wave length of 5.570 units. The identity of the two is such that Sir William Ramsay has been led to the conclusion that the aurora may be produced by electrical discharges in the upper atmosphere through a gas in which krypton is present in considerable amount. He has calculated the maximum height of an aurora on the supposition that the krypton line is no longer visible when the pressure falls below 0.000035 millimeter, the pressure observed when in a mixture of krypton and helium the green light of krypton becomes faint and almost invisible. From this he concludes that the height of an aurora is about 135 kilometers, or 84 miles. Prof. Birkeland places the altitude at 100 to 200 kilometers, or 62.5 to 125 miles. Hence there is a fair agreement between Ramsay's and Birkeland's estimates, although arrived at by entirely different means.

Whatever may be the cause of the aurora it cannot be denied that the phenomenon is the most beautiful of the earth's frigid zones. Perhaps the most eloquent description of an aurora is that which has been penned by Alexander von Humboldt, which reads as follows:

"Low down in the distant horizon, about the part of the heavens which is intersected by the magnetic meridian (i. e., the point to which the compass-needle is directed), the sky, which was previously clear, is at once overcast. A dense wall or bank of cloud seems to rise higher and higher, and it attains an elevation of 8 or 10 deg. The color of the dark segment passes into brown or violet, and stars are visible through the smoky stratum, as when a dense smoke darkens the sky. A broad, brightly luminous arch, first white, then yellow, encircles the dark segment. . . . The luminous arch remains sometimes for hours together, flashing and kindling in ever-varying undulations before rays and streamers emanate from it and shoot up to the zenith. The more intense the discharge of the northern light, the more bright is the play of colors, through all the varying gradations from violet and bluish-white to green and crimson. The magnetic columns of flame rise either singly from the luminous arch, blended with black rays similar to thick smoke, or simultaneously in many opposite points of the horizon, uniting together to form a flickering sea of flame, whose brilliant beauty admits of no adequate description, as the luminous waves are every moment assuming new and varying forms. Round the point in the vault of heaven which corresponds to the direction of the inclination of the needle, the beams unite together to form the corona—the crown of the northern light—which encircles the summit of the heavenly canopy with a milder radiance and unflickering emanations of light. It is only in rare instances that a perfect crown or circle is formed; but, on its completion, the phenomenon has invariably reached its maximum, and the radiations become less frequent, shorter, and more colorless. The crown and the luminous arches break up, and the whole vault of heaven becomes covered with irregularly scattered broad, faint, almost ashy gray, luminous, immovable patches, which in their turn disappear, leaving nothing but a trace of the dark, smoke-like segment on the horizon. There often remains nothing of the whole spectacle but a white, delicate cloud, with feathery edges, or divided at equal distances into small roundish groups, like cirro-cumuli."

Holes for tree planting have been excavated by the Long Island Railway by blasting with dynamite. Two men can excavate 250 holes per 10-hour day at a cost of about 7½ cents per hole.

MAKING THE EYE OF SCIENCE.

BY C. H. CLAUDY.

Ask a man in the street what a lens is, he will probably answer: "A piece of glass." A lens is, indeed, usually a piece of glass, unless it is made of several pieces. So is a house several pieces of wood, a locomotive many pieces of steel, and a watch a collection of wheels and springs. But the house, the locomotive, or even the watch does not require more exquisite care than the making of a lens. The mechanical error in architectural work may be measured in fractions of a foot, in locomotives in fractions of fractions of an inch, in watches in fractions of a millimeter. In lenses it is measurable in microns, and a micron is *the thousandth part of the thousandth part* of a meter.

The lens for microscopes, the lens for telescopes, the lens for cameras, for spectroscopes, for 'scopes with all sorts of prefixes, each carries its own special standard, highest of all in microscopes, in cameras, and in telescopes. Telescopic lenses, with their large size and huge cost, are more or less familiar to the reading public, but comparatively little is known of the making of the eye of the magic tube which shows what the human eye cannot see, and the eye to that other equally magic tool of science, as well as plaything of us all, which limns, in a fraction of a second, a picture more perfect than the most expert artist could draw in a lifetime.

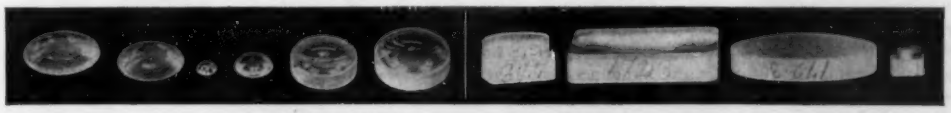
The first step in making any kind of lens is the procuring of the glass. Optical glasses of the newer kinds cannot be made anywhere and everywhere. Practically all of it is made in Jena, Germany. To the crown and flint glass of the earlier opticians, science has added a large number of new and different kinds which have in themselves, without curvature, many different properties, different refractive indices, and, extremely important, different dispersive abilities. A lens not only refracts or bends light rays in a certain degree, depending on both curvature of surface and composition of material, but it disperses color, separates the spectrum, or refracts different colors of light differently, in a manner dependent largely on its chemical constitution.

In making a microscope objective, or a telescopic lens, or the lenses for cameras, it is the great aim of the optician to eliminate color fringes about the images formed, because they interfere seriously with the accuracy of observations or the perfection of pictures.

The proper glass obtained and the curvatures determined, the next step is grinding. But it should be understood that neither the fine photographic lens, usually termed an "anastigmat," because free (over a certain area of image) from the aberration of astigmatism and its kindred ills, or the wonderfully tiny microscopic objectives, are made of one piece of glass. The mathematician who calculates the lens puts curve against curve, glass against glass, refraction against refraction, dispersion against dispersion, until one corrected element balances the undercorrections of another. It would be simple enough if the making of a lens were merely the simple grinding of one piece of glass on both sides. It is the grinding of many glasses to form one lens, and making them fit both conditions and each other, that taxes both the man and his methods. All lenses, both photographic and microscopic, are ground by hand. The glass is cemented to a tool called a "block," and pressed with an abrasive and water into a revolving metal shell of proper curvature. The shell revolves, and the block revolves, the grinder constantly changing the angle of the block, so that all parts of the glass are ground evenly. Necessarily, all such lenses are ground on the section of a sphere. They are ground three times — "rough," "second," and "fine" grindings they are called—before being polished with rouge and time and care until the last faint abrasive mark is taken out, and nothing but the high "black" polish of the perfect lens remains.

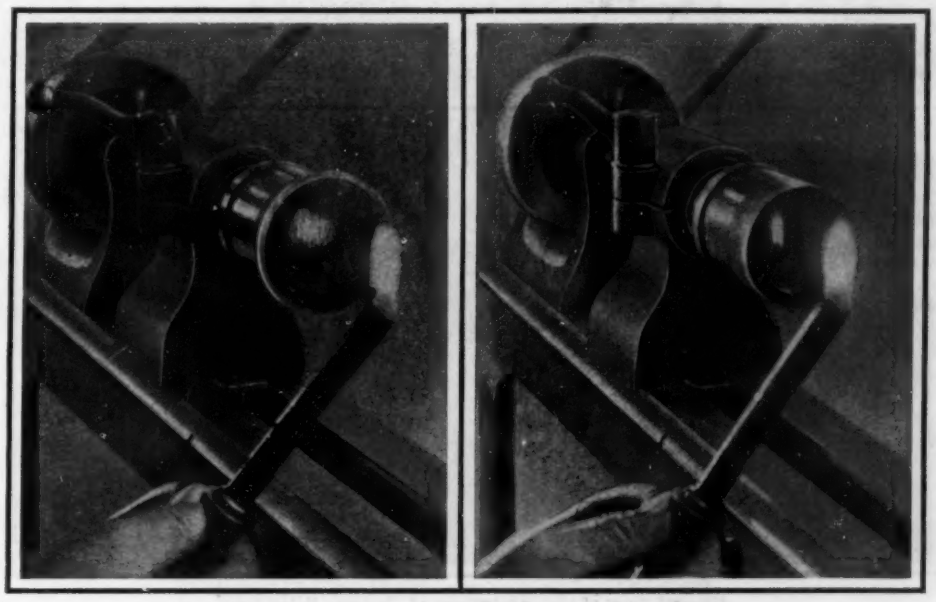
If the glass is to be a component of a fine photographic lens, it has now to undergo an ordeal. Two blocks of perfectly homogeneous optical glass have been formed to the shape of the lens element and curve to be tested. Every possible care has been taken in the making of these test glasses, and optical, refractive tests, far more delicate than any measuring engine test could possibly be, have shown them to be as absolutely perfect examples of the desired curvatures as science and art can make. So that if the element tested exactly and perfectly fits this test glass, it is, obviously,

(*Continued on page 431.*)



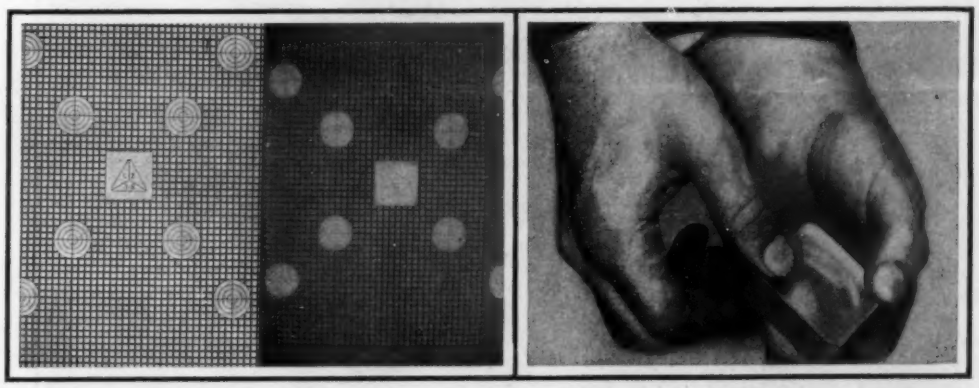
Elements of a one-twelfth inch microscopic objective (enlarged).

Glasses which are used for testing an anastigmat lens.



In the picture on the left the flame dances as the lens is revolved and is stationary in the picture to the right. Observe the untrimmed edges in one and the trimmed edges in the other picture.

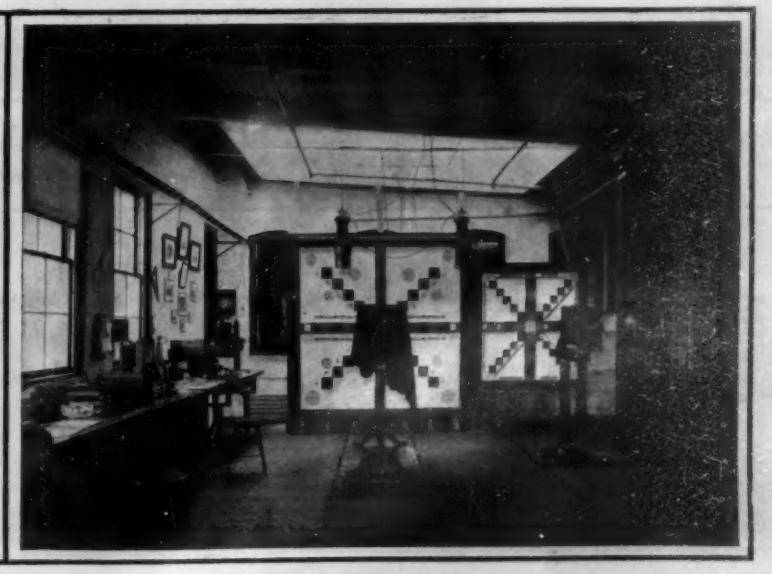
How the elements of an anastigmat are centered.



Photographs of a test chart made by a good and a poor photographic lens.

Using the test glass on an element of an anastigmat lens.

Grinding photographic lenses by hand.



Room for testing photographic objectives.

MAKING THE EYE OF SCIENCE.

EXCAVATIONS AT JERICHO, PALESTINE.

BY HAROLD J. SHEPSTONE.

Few excavations have evoked wider interest among the general public than those which have been carried out on the supposed site of the ancient city of Jericho—that city whose walls, according to the Biblical story, fell so miraculously before the trumpet blasts and shouts of Joshua's army. The excavations were carried out during the winters of 1906-7 and 1907-8 by Dr. Selin, who, although an Austrian, represented a German society, the Deutsche Orient Gesellschaft.

The scene of the excavations is a collection of mounds in the vicinity of the village of Ericha, near the Dead Sea. The mounds were attacked from five different points practically simultaneously. The "finds" have been remarkable. It was not long before the exterior wall of the lost city was encountered at a depth of only 8 feet below the surface. The excavators were astonished at the technical excellence of the construction. The wall consisted of three parts. The natural rock foundation is overlaid with a filling of loam and fine gravel, four feet or so deep, upon which a sloping rubble wall, with a marked batter, is superimposed to a height of 20 feet, the breadth being from 6½ to 8 feet. The wall is built of well-laid rubble, which becomes finer toward the top. Numerous blocks are partially employed for the lower part of the wall.

Every interstice is most carefully filled in, so as to offer no advantages to the implements of destruction of a hostile force. Finally, upon this imposing foundation the fortification wall proper rests, built of clay bricks. In one place this part of the wall reaches to a height of 8 feet, but it would seem to have been considerably higher. The whole must have been a most striking structure, which dominated the whole plain without the city and must have been visible for miles.

The only advantage which, in point of technical perfection, modern construction possesses over the walls of Jericho is the use of mortar, which was unknown to these early architects. The walls are estimated to have extended 900 yards, of which 450 yards have already been laid bare with the aid of 200 workmen employed by the Society. To the north, the fortifications are breached by a large heap of rubbish, which would seem to indicate that an attacking army must have penetrated here some time.

Because these may have been the very ramparts that confronted Joshua's hosts, excavations have attracted not a little interest. Here it must be borne in mind that the site of ancient Jericho is almost entirely a matter of conjecture, and the name of the town—"The City of the Moon"—makes traditional evidence of little value, because it is more than probable that a number of cities were called by the same name. If the Bible story is to be accepted, we have here a definite announcement that the city was razed, whereas the walls discovered are, it appears, in a singularly good state. It is interesting to learn that the wall formed a strong rampart around what was undoubtedly one of the most ancient cities of Palestine. Some interesting relics have been found. They include lamps, plates, cups, needles, weights, mortars, and mills of bronze and stone, some of very rough and primitive handwork, and others very finely executed.

General view of the excavations at Jericho, Palestine.

The deep excavation on the right discloses the old wall of Joshua's time. This rampart extends around the ruins and has been uncovered for some distance. The foothills of the Judean mountains are seen in the distance.

Unearthing the Biblical city of Jericho.

In the inner city remains of rows of houses have been uncovered. Below the clay floors of some of these were found the bodies of children buried in jars. Ancient Hebrew inscriptions are found on some of the dwellings.

The interior or inner wall has also been unearthed for a considerable distance. This, like the outer wall, was crowned by strong corner towers. On the northern slope of the city, without the walls, numerous remains of Canaanite houses were discovered. Some of these leaned against the old city wall, and recalled, as one writer points out, the "Home of Rahab," in which Joshua's spies took refuge. The partition walls of clay were in many cases still standing, and even ovens and a drainage canal were still to be traced. The excavators believe that this slope was inhabited from the end of 2000 B. C. up to the last few centuries before Christ. At five different places flights of broad stone steps were discovered, but they are held to belong to a later time when the city lay deserted, and the once inhabited higher parts were used for gardens and vineyards.

Jericho was thrice rebuilt. The first city, believed to have been destroyed in 1451 B. C., was replaced by the one built by Hiel in 918 B. C., in the reign of Ahab; and this, having been looted by Simon, slave to Herod, gave way to the one built by Archelaus, son of Herod. The final destruction was the work of Vespasian in 68 A. D.

There was also discovered what must have been a neighboring village, consisting of some fifty dwelling houses. It was, however, evidently erected about 700 B. C. One of these excavated houses was particularly well preserved. It contained a courtyard open to the air, with a bench, a long room, and a kitchen opening on to the yard, in which the great water tun still stood in its accustomed place.

Although the excavators have been rewarded with rich finds there is still much work to do, and one is glad to note that the work is to be resumed during the present spring. It is hoped then that Dr. Selin and his experts will be able to determine the epochs represented — Canaanite, Israelite, Jewish.

During the last quarter of a century many interesting archæological discoveries have been made in Palestine. Unfortunately, research in the most promising districts, such as Jerusalem and Nineveh for example, is to a large extent impossible, because of the buildings upon the ancient sites.

View from the west of the great mound which covers the ancient city of Jericho.

EXCAVATIONS AT JERICHO, PALESTINE

Handy Man's Workshop

TOOLS FOR THE WORKSHOP.—III.

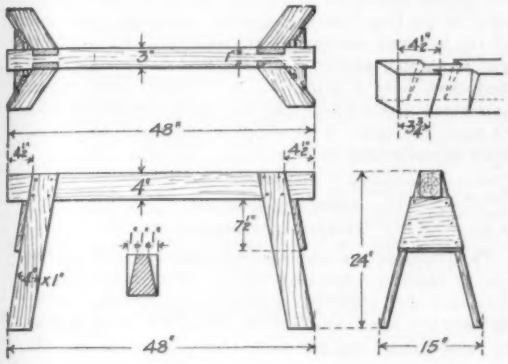
BY I. G. BAYLEY.

(Continued from issue of May 15th.)

A ROLLER JACK.

For moving heavy timber and other uses, a roller jack will be found very handy. It is easily constructed, any amateur being able to do the blacksmithing required. The framework should be made of oak or heavy tough wood; the roller of pepperidge or sour gum, a wood which will not easily split. The bottom face of the framework is in the same plane, in other words lies flat on the ground at all points.

The general dimensions are given for the construction on the sketch. The 3½ by 2-inch braces should be connected to the side pieces with mortise and tenon joints, and secured in place with wooden drift pins. Wrought-iron plates are bolted to the upper face of the sides, for the roller axles to wear on. These plates should project over the sides a little as shown, to take the wear of the washers on the axles. These washers are made from staples bent around the axles, which are three-quarters of an inch diameter, round iron. The axles are round at one end and square at the other; the square end being driven into the roller with a driving fit. The bearing ends of the axles are ¾ inch in diameter.

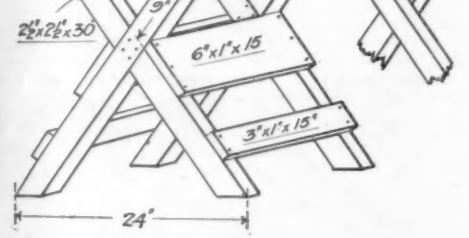


CONSTRUCTION OF A TRESTLE.

TRESTLES, HORSES, OR STOOLS.

They go by either of these names. Though simple enough, and at first thought almost unnecessary to refer to, it will be found by observation that few mechanics have a perfectly-built trestle.

The length should be twice the height. The 3 by 4 piece should be on edge, and it should bear squarely upon the end boards, which in turn should be secured to the legs with screws or nails. The legs should slant in two directions; their bearing location longitudinally being in line with the ends of the 3 by 4 piece, as shown, so that the trestle will not tilt. Full dimensions for construction are given on the various views, and need not be repeated in the text. The notches for the logs are shown in larger scale views, and are dimensioned in such a manner that no trouble need be experienced in cutting them out.

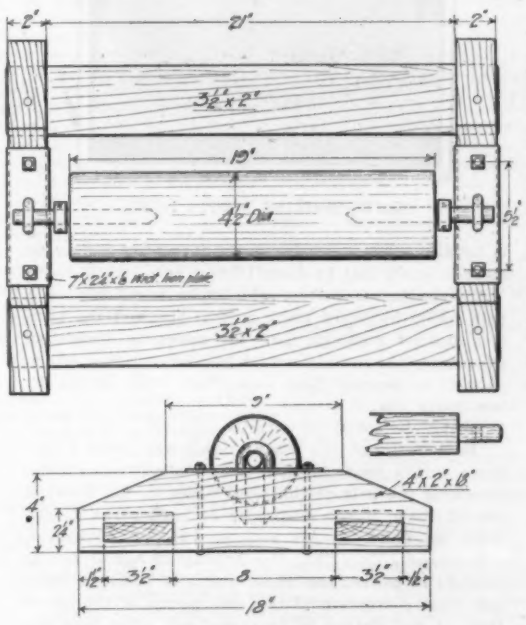


THE SAW BUCK.

The saw buck is made from 2½ or 3-inch stuff, 30 inches long, half-jointed, 9 inches from one end, as shown, the feet being spread 24 inches out to out. Battens, 6 inches by 1 inch, with the top edges bearing squarely against the legs, secure the latter together, 10 inches apart inside measurement. A 3 by 1-inch strip at the bottom on each side serves as a foot rest.

THE GRINDSTONE.

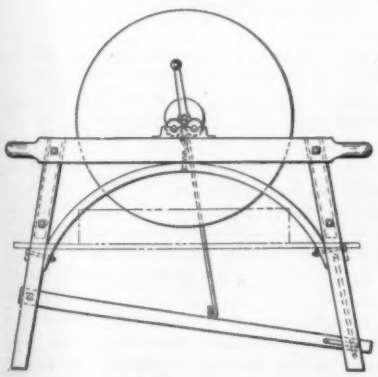
The grindstone is generally purchased with frame complete as shown. The frame is usually 24 inches high by 38 inches in length, out to out of handles, which are made of 2½ by 1⅝-inch stuff, shaped at the ends to 1½ inch diameter by 4 inches long. The legs are 1¾ by 1½ inches, spread at the base 33 inches one way and 11½ inches at the ends, inside dimensions. The handles are spaced 9 inches apart outside dimensions. A piece of timber 1¼ inches thick by 10 inches deep is bolted to the legs at each end. The treadle rod and guides are made of ¼-inch round iron. The stone can be turned by hand or foot power, the handle being easily removed. The bearings are shown with the dust cap removed, to show the rollers. Under the stone is shown, in broken lines, a wooden water trough resting upon a 1-inch board, which in turn rests upon two strips nailed to the legs. Some mechanics object to this manner of wetting the stone, claiming that it washes off all the powdered stone necessary for the grinding process. Instead they put an ordinary tin can, with a small hole punched in the bottom, just above the stone, allowing the water to drop on the stone instead of washing it.



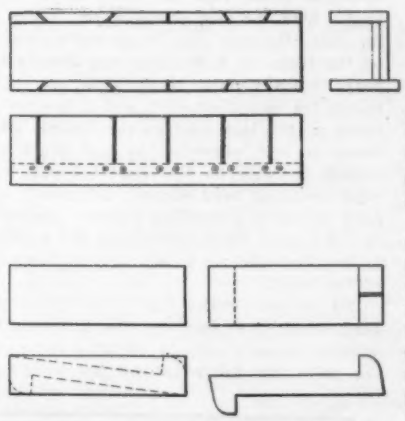
PLAN AND END VIEWS OF THE ROLLER JACK.

MITER BOX.

Beech, a strong and durable close-grained wood, should be used in making a miter box. Make the box of 1-inch stuff, planed down to ⅞. The length will vary according to whether the 60-degree miter cuts are used, in addition to the 45-degree and the right-angle cuts, in which case the box should be about 30 inches in length.



FRAME CONSTRUCTION FOR GRINDSTONES.



THE MITER BOX AND THE BENCH HOOK.

One of the sides and the bottom are made of 6-inch wide material, the other side being 7 inches wide, so that it will project below the bottom of the box 1 inch, forming a ridge to bear against the work bench when sawing.

The positions of saw cuts should be laid out very accurately in pencil first, and when sawing them care taken to keep the saw over the pencil lines in the horizontal and vertical lines. The sides should be secured to the bottom with screws or nails at points each side the saw cuts. It is a very good plan to lightly tack a narrow board to the bottom of the box, as indicated by the broken line, to protect it from the wear of the saw.

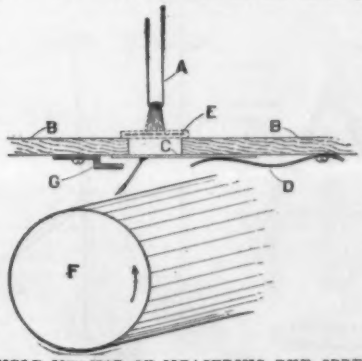
BENCH HOOK.

A bench hook can be made from a piece of beech wood 3 by 2 by 9 inches in length. Cut out as shown in dotted lines, and round the ends. The saw cut should be vertical and at right angles to the cross piece. When one side of the hook is worn, it can be turned over, and the other side be used.

A SIMPLE METHOD OF MEASURING THE SPEED OF PHOTOGRAPHIC SHUTTERS.

Quite a new principle in methods for measuring the speed of a photographic shutter is embodied in an apparatus invented by Mr. W. H. Smith of Croydon, England, and first shown and described at a meeting of the Royal Photographic Society in London recently. From the drawing it will be seen that the method dispenses with elaborate apparatus. Though it supplies a record on paper of the time the shutter remains open, no photographic operation is necessary, and a test can be made in a few seconds, more quickly than by any of the many devices suggested or constructed for this purpose.

A is a glass tube through which a current of air is blown from a bellows or from the mouth of the operator. *B* is a board in a small aperture, in which a thin light plate of mica, *C*, is held by a light metal spring, *D*. To the lower side of the mica plate is fixed a tiny brush dipped in a strong solution of an aniline color. A stop, *G*, serves to limit the movement of the mica plate in either direction. Below the plate a drum, *F*, covered with paper, is rotated at a constant known speed by means of a small motor, such as is used for gramophone disks.



A SIMPLE METHOD OF MEASURING THE SPEED OF PHOTOGRAPHIC SHUTTERS.

The shutter to be tested is laid on the board so as to cover the aperture. On a current of air being blown through the tube, and the shutter immediately released, the mica plate is depressed, and the brush thereby caused to remain in contact with the revolving drum as long as the shutter is open. The distance traversed by the drum during the time the shutter is open is thus recorded by a line of color; and if the number of revolutions made per second is known, the speed of the shutter is a matter of very simple calculation.

Thus, supposing that the drum is 10 inches in circumference and makes two revolutions per second, a line 20 inches in length represents one second, and therefore a line, say, half an inch in length indicates a shutter speed of one-fortieth of a second.

Owing to the enormous speed attained by air currents, any error due to the distance between the shutter and the mica plate is extremely minute, that is to say, is immeasurably smaller than the variations produced, in consecutive operations of shutters of certain types, from changes in the temperature or the moisture of the atmosphere. The whole apparatus, exclusive of the motor for operating the drum, does not cost more than a few cents.

A SUBSTITUTE FOR TINFOIL IN LEYDEN JARS.

BY REV. L. J. KAVANAUGH, S. J.

The deposit of silver from a mirror solution is a convenient and effective substitute for the tinfoil on the inside of Leyden jars. It lies close, and presents no points or sharp edges to invite a puncture of the glass. I have never seen this process suggested, and, on the chance of its being a novelty, I submit it to you. It very much enlarges one's choice of bottles, as one is not obliged to sacrifice a flask of good dielectric proper-

ties because it has too narrow a mouth for convenient manipulation of the tinfoil. The suggestion may have other applications; for instance, a pair of thin glass test tubes, silvered in this way, serve very well in the construction of Regnault's hygrometer.

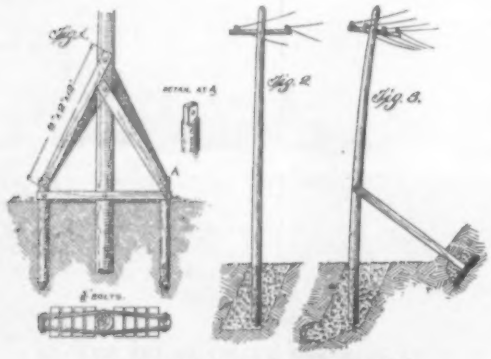
The easiest way to get proper silvering solution is to go down to the mirror maker's with the flasks that need the coating. The solution can be purchased for a trifle. The following formula will do very well: A. Rochelle salt 10 grammes in 1 liter of water. B. Silver nitrate 5 grammes dissolved in a little water. Add 3 grammes of strong ammonia gradually, so that the precipitate at first formed is dissolved. Add water enough to make 1 liter. Mix equal parts of A and B. The glass ought to be perfectly clean and at a temperature of 25 deg. or 30 deg. C. In about half an hour the deposit is complete.

WAYS TO BRACE POLES FOR PRIVATE TELEPHONE LINES

BY THALEON BLAKE.

The extension of telephone lines to rural districts is one of the real blessings modern science and business enterprise have bestowed upon the farmers. Most of these spurs and cross-country lines are made at the expense of the telephone companies; but sometimes, when the number of subscribers does not warrant it, the prospective customers must furnish or erect their own poles. Even if these are done by the companies, many boys may desire to unite their neighbors' houses with theirs by private telephone or telegraph lines. Telegraphy is a fascinating study to boys. To those who contemplate the erection of a private telephone or telegraph line it may be informing for them to examine these designs of two ways of bracing poles. In fact, the plans are worthy of any farmers' attention who uses poles for any purpose whatsoever about the farm.

It is to be remarked, first of all, that poles get out of plumb and alinement because of wind pressure and wire strain. Eliminate these two stresses upon any



HOW TO BRACE A TELEPHONE POLE.

pole, and unless it be located at the edge of quicksand, or abuts a living spring of water, it will very likely remain erect until it decays. Fig. 1 shows a form of bracing that is excellent to aid a pole to withstand the rocking effect of the wind. Most winds are unsteady in effort, and this accounts for so many poles leaning, for the pressure of the wind comes and goes suddenly, each gust being followed by periods of lull, so that a pole rocks, swinging out with the gust, and back with the following lull. The design is self-explanatory, and is intended for a full-sized pole, set seven feet in the ground. But poles to carry two to four wires need not be so large, either in diameter or in height, nor be set so deeply in the ground. The perpendicular braces, coupled at the top by horizontal timbers, are efficient to withstand the rocking effect of the pole. The oblique braces are also valuable assistants. Strange as it may appear, when oblique braces are used alone, they tend to lift a pole out of the earth as it rocks back and forth. The horizontal braces do not have this tendency. Perhaps children have observed that their swing poles, when braced by oblique braces only, have gradually become loosened and lifted by swinging. This system of bracing poles, therefore, is to be recommended for children's swings. The design shows the parts well proportioned, and they may be proportionally reduced in dimensions in working them out.

Fig. 2 shows how cement may be substituted for wooden braces at a bend of the line where the wind and wire strains are not too severe. The hole in the ground is dug obliquely, the pole is set upright, and the triangular spaces on both sides are filled with cement. Odd-shaped poles, should it be necessary, may be used anywhere when properly braced. One good way of bracing such a pole is portrayed in Fig. 3. A toe of cement may be extended into the ground to give the cement a "grip." If it is still required to have a stronger support, a wooden brace may be affixed as shown, its bottom resting on a large flat stone, with or without a cement binding.

By either of these methods, a private line of telephone or telegraph wires can be maintained against the blasts of Boreas himself, whether the old mythological god blows hot or cold, hard or easy.

THE DRIVING OF A NAIL.

BY W. D. GRAVES.

The driving of a nail is deemed so simple a matter, that inability to do the job is often spoken of as though typifying entire lack of mechanical ability; yet it may be that some skilled mechanics have something to learn in regard to this elementary operation.

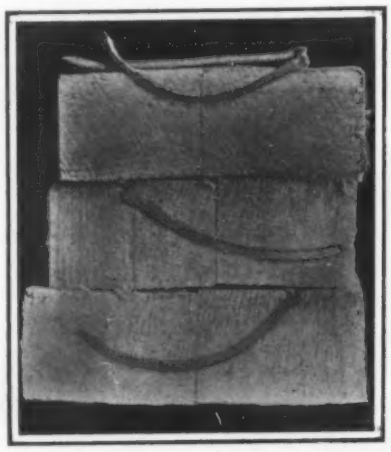


Fig. 1.—NAILING A BUTT JOINT.

It usually takes a woodworker's apprentice a year or more to learn that he doesn't know how.

A fledgeling mechanic, who spoke sneeringly of a man whom he heard using several blows of the hammer to drive a shingle nail, was somewhat crestfallen when told that the nail would hold better when driven "home" by several light taps, than when driven by one heavy one.

"Why?" he asked, in surprise.

"Because," said the other, "when you drive a nail home with a heavy blow, it is apt to rebound a trifle, loosening the grip of the wood fibers on it. Drive it *almost* down, if you will, with as hard blows as you wish, but finish the job with several light blows."

One who thinks that the driving of a nail simply consists in getting the whole length of it out of sight, has little conception of the real nature of the operation. A nail driven by an expert will often hold several times as much as one ill driven; while, too, it is often made to draw the parts into place. If you have ever watched a mechanic driving nails, you have doubtless noted that he rarely drives one at right angles with the face of the work. There is a reason for this. Suppose that he is nailing the "sheeting" on the frame of a building, and desires to draw the board down tightly against the one below it; he points the nail downward, and a few well-considered blows at the last produce the desired effect. If the board is bent edgewise, so that much force is required, probably he will start the nail in the upper edge, pointing very sharply downward. Again, two nails driven in a board at different angles will hold it in place much more firmly than the same nails would if they were driven in at right angles with the face of the board.

Did you ever notice that, in driving a nail in very hard wood, one man will do it successfully, while another succeeds only in doubling the nail up before the point has fairly entered the wood? The differ-

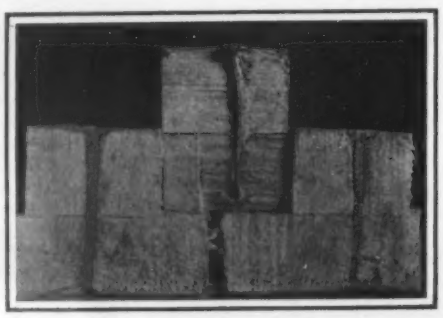


Fig. 2.—METHODS OF CLINCHING A NAIL.

ence lies in the fact that the expert strikes the nail fairly, and not too hard, "coaxing" it in; while the other strikes too hard and with indirection. It may be profitably mentioned, right here, that in driving a nail into very hard wood, it is usually profitable to dip the end into oil or grease. This will not sensibly interfere with the holding qualities of the nail, while it will very materially facilitate its driving.

In order that a nail may hold its best, it is necessary that the pieces it penetrates should be in close contact. A few well-judged taps of the hammer at the finish will serve to bring about this contact; while a heavy, ill-judged blow often destroys it, on account of the rebound.

So, too, the direction in which a nail goes is governed, not merely by the direction in which it is started, but very largely by the shape of the point. You have doubtless noticed how a horseshoe nail, by having a chisel point, is made to swerve and to come out of the hoof but little above the shoe. By filing the point of a nail off on one side, it may readily be made to take a curved course in driving, or the same result may be attained by bending the point slightly with the claws of the hammer. The photograph, Fig. 1, shows how two boards may be secured, edge to edge, by nails bent in this way.

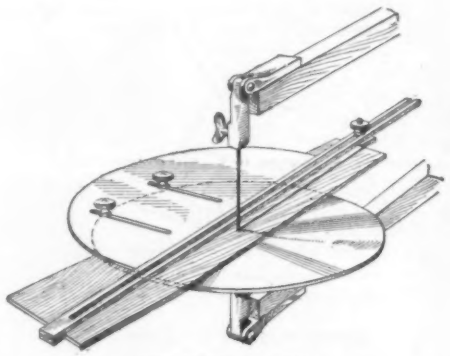
In driving a clinch nail, there is room for the exercise of some skill. In Fig. 2 the central figure is that of a clinch nail driven down onto a hard surface, thus being driven and clinched at the same operation. It will be noted that it is bent in the middle, "crippled," thus loosened in the wood and deprived of much of its holding capacity. At the left and right are nails which were first driven through the wood, and had the points bent over afterward, while a heavy hammer, or the like, was held against the head. The one on the left was carelessly bent, leaving a clinch which will straighten easily; while the one at the right was first bent over a trifle at the extreme point, then hammered firmly down. By the latter method, it will be seen, the point is driven into the wood, and thus more securely held in place.

SCROLL-SAW GUIDE.

BY W. AND K. PARKHURST.

The object of the device here illustrated is to enable one to obtain a true edge with a scroll saw.

On the saw plate is clamped a semicircular guide, by means of two thumbscrews. The guide plate should be raised from the saw-plate about ⅛ of an inch by running several washers on the screws between the



SCROLL-SAW GUIDE.

two plates, so that the article to be cut may be slid under the guide, as is hereafter explained. Two slots about 3 inches long should be made in the guide to receive the screws and permit adjustment of the plate.

A strip of ¼-inch walnut about two feet long and one inch wide is procured and a quarter inch slot is cut in it extending nearly its entire length. A thumbscrew is fitted to run in this groove and engages a block which is adapted to slide along the under side of the strip. At one end of the strip a permanent block is fastened.

To make a straight cut in a board at any prescribed angle with one of its edges the walnut strip is fitted to it parallel to the line of the desired cut and so that the two opposite extremities of the board are clamped between the permanent block and the adjustable block. The guide plate is then clamped in position, its edge parallel to the plane of the saw, at such a distance that when the strip is placed against the edge of the guide, the saw will exactly coincide with the line to be sawed.

GAGE FOR AUGERS.

BY L. G. HANDY.

When boring a number of holes to the same depth, it is of considerable advantage to have some means for marking positively the extent to which the bit should penetrate the wood. The accompanying engraving illustrates a very simple attachment for this purpose. It consists of a piece of soft iron or copper wire about 8 inches long, bent double and formed with a foot at the top end. Wind the free ends tightly about the auger as shown. The gage will be adjustable. When using be careful not to bring the foot into actual contact with the edge of the hole.

GAGE FOR AUGERS.

RECENTLY PATENTED INVENTIONS.

Pertaining to Apparel.

ARCH-SHANK FOR SHOE-SOLES.—T. F. EATON and C. E. EATON, Brockton, Mass. The invention consists of an arch supporting shank of sheet metal, having tongues stamped therefrom to secure the shank to the shoe sole, with the tongues arranged near the opposite ends of the shank, and the points thereof as stamped out, directed outwardly, and longitudinal ribs pressed in the shank from its under side and respectively arranged at the opposite sides of the tongues.

GARMENT-HANGER. — A. WILKIN, New York, N. Y. The device serves to support a number of articles of clothing, and in general consists of a hanger bar adapted to support a coat or waist, and a resilient clamp secured to the bar, this clamp being adapted to support trousers, or the like, between its two lower portions, which constitute the clamping members of the device.

FOLDING STORM-LEGGING.—T. D. MILLER, New York, N. Y. The more particular purpose in this case is to provide a legging suitable for folding in order to be readily carried in the pocket or in a case when not being worn, and further provided with various details for construction whereby its general efficiency is improved. Provision is made for partially supporting the legging upon a shoe top.

Electrical Devices.

APPARATUS FOR AUTOMATICALLY THROWING OUT THE RESISTANCE IN CHARGING STORAGE BATTERIES.—G. PATTBERG, New York, N. Y. The invention resides in the adaptation of a single magnet for closing the motor circuit preparatory to the change of battery resistance and interrupting the said circuit after the change of the battery resistance is completed; a circuit breaker and controller therefor, adjustable to throw out the circuit breaker and cut off the source of supply when the battery is charged to a degree corresponding to a predetermined point along the resistance.

RELAY.—H. C. RICE, Denison, Texas. The idea in this case is more particularly to produce a relay normally actuated by weak currents, and adapted when abnormally energized by heavier currents to shift the local circuit from one connection to another in order to prevent the relay armature from sticking.

Of Interest to Farmers.

CORN HARVESTING AND HUSKING MACHINE.—F. W. WELLENSIEK, Syracuse, Neb. The machine is designed to positively remove the ears of corn from the stalks as it moves over the field, provision being made for the lateral yielding separation of the picking rolls by which the harvesting is accomplished thus preventing the choking of the rolls when in operation.

BALING APPARATUS.—P. PILON, Silver Bay, New York, N. Y. In this open-ended box form leaves are packed for baling, preferably tapering from bottom to top, with the enlarged end at the bottom, and a handbarrow forming the bottom of the form. In the form, before filling in the leaves, is placed one or more flexible ties, and also corner bars, the latter resting on top of the ties. The form is then filled and well trodden down, and the ends of the ties drawn taut and joined after corner bars are seated on the top.

MOWER.—H. NORMAN, Fowler, Kan. The cutter bars are carried ahead of the team, and has a main frame mounted on wheels and driven by horse power, and on this is mounted a rocking platform which carries an engine such as a small gasolene engine, with a pair of cutter bars in front and driving devices or gearing at the middle line of the machine, between the inner adjacent ends of the bars and the engine, whereby the engine drives the cutters.

GUARD.—D. D. OGILVIE, Lee, Nev. The guard is such as used on mowers, reapers, headers, and the like, in which the ledger plates can be readily detached from the guard, to be ground. The invention provides for the continuous and gradual cutting of the grass, etc., instead of simultaneously cutting it in bunches, as the usual practice, this latter manner of cutting causing vibration and often breaking the knives.

ADJUSTABLE WHEEL FOR CORN-PLANTERS.—J. A. MUSSETTER, Wilmington, Ohio. This improvement is upon the wheel for which Mr. Mussetter formerly received Letters-Patent of the U. S. Such wheel is made in two parts, which are adjustable toward and from each other, whereby the two-part oval rim may be broadened or narrowed as conditions require. The bar braces used as the principal means for holding the halves of the wheel in different adjustments relative to each other are now dispensed with, and he substitutes means applied to the hub and to the spokes adjacent to the rim.

CATTLE-GUARD.—J. A. LEE, Salt Lake City, Utah. The cattle guard is for use along a railroad track at a crossing. The device will readily yield to any dragging material, such as connecting hose, and at the same time form a complete guard against the trespassing of live stock of all kinds.

Of General Interest.

WELL-SCREEN.—W. A. ARCHER, Topeka, Kan. The discovery has been made by Mr. Archer that a matting consisting of woven cocoanut fiber, when sunken into a well and properly mounted, permits percolation of water through it and at the same time effectively prevents all silt, whether in the shape of fine grain sand or of quick-sand, from entering the well. It keeps out of the well mud which would easily pass through the meshes of almost any other screen. A screen made in this manner is practically indestructible and immune from the deleterious influences which cause so many other screens to become useless.

BURIAL-VAULT.—E. D. MILLHOUSE, Wabash, Ind. When in use, after the box is placed within the vault, plastic material is placed upon the ledge, and the cover is lowered into place. The weight of the cover forces the free edge of the flange into the plastic material, which is forced into all the crevices, thus effectually sealing the vault. The weight of the cover is supported by the free edge of the box, and the fresh plastic material is prevented from displacement by the overhanging outer edges of the flange, and of the rib.

PRINTING-PRESS CHASE.—E. KARL, Litchfield, Conn. The chase is constructed with the usual frame and slidably supported in its longitudinal and transverse inner edges, bars, each bar consisting of a number of longitudinally spaced members rigidly connected together, and with the members of the bars running in one direction passing through the spaces between the members of the bars running in the opposite direction whereby both the longitudinal and transverse bars extend substantially the full depth of the frame.

CABINET.—F. A. HAYDEN, Pilot Point, Texas. The casing is provided on its side walls with a plurality of horizontal series of alined slots, a pair of brackets secured to the inner wall of casing at each slot, the members of the pair being arranged at each slot end, a reel journaled between each pair of brackets, a cross piece connecting brackets between the reels, a shaft journaled in the side wall of casing and in cross piece adjacent to each reel, a pinion on the inner end of the shaft, and a crown wheel on the reel with which the pinion meshes, the outer end of shaft being provided with a gearing.

BABY-JUMPER.—G. T. GILSON, Lewiston, Idaho. The seats are hung from an overhead support, and the purpose of the invention is to provide a construction for a device, that affords a safe, comfortable seat for a small child, whose natural motions will cause an elastic jumping movement of the seat and its occupant.

DRINKING-CUP.—AUGUSTA DACUS, San Antonio, Texas. An object of the invention is to provide a collapsible cup, in which the cup proper is secured to the bottom part of an inclosing casing and the upper half of the casing, as well as the lower half are fastened together, the fastening means in turn being secured to a hook that can be attached to the belt of the user or to the waist button or other part of the clothing.

HAIR-DRYING APPARATUS.—W. A. SOLES, New York, N. Y. The aim is to provide in this instance an apparatus for private or hairdressers' use, and arranged for convenient attachment to the wearer's head, to serve as a valuable therapeutic agent for the hair, and to properly dry it without danger of bleaching or otherwise injuring the same.

COMBINATION TENT-BAG.—A. L. STRAWN and F. C. SPENCER, Monte Vista, Colo. The side pieces of the tent are of such length relative to the floor cloth as to form a cover in the use of the device as a sleeping bag. Before turning the sides in over the cover the latter is brought forwardly over the floor cloth and folded back, after which the sides are brought in and secured, the fastening which secures the sides together being arranged midway between the edges of said sides so that the latter are also doubled when in a folded position.

ATTACHMENT FOR PLUGS OF OIL OR GREASE CUPS.—J. TOWERS, Albuquerque, New Mexico. The oil or grease-cups applied to locomotives or other engines, or compressors, are commonly provided with a screw-plug which is adjusted by rotating it for the purpose of expressing oil or grease as required. The constant jar or vibration to which the parts of the engine may be subjected tends to loosen the plug so that it rises more or less in the cup and thus fails to perform its function. The attachment prevents this result.

PORTABLE DARK ROOM FOR PHOTOGRAPHIC PURPOSES.—C. BURR and H. F. THOMAS, Natrona, Pa. In the present invention the improved dark room is adapted, like stationary ones, for use in loading plate holders, developing negatives and printing photos, and is so constructed as to be collapsible and thus easily portable and adapted to occupy small space when out of use.

ORE-SEPARATOR.—R. M. CLARK, Webb City, Mo. The invention is embodied in an attachment for jiggers, the same comprising a metal box of the form and construction adapted for insertion and use in a jig box, and having a horizontal top forming the overflow line and a series of horizontal slots, and a slidable gate provided with corresponding slots and a nut and screw for adjusting such gate to vary the size of the openings through which ore is discharged.

HORSESHOE.—J. H. FAWKES, Detroit, Mich. An object of the inventor is to produce a horseshoe of light weight, yet strong and durable. A further object is to make a shoe that is provided with hardened non-slipping devices and a softer wearing part so that the non-slipping devices are always exposed, thereby rendering the shoe always sharp.

MOUNTING FOR EMBLEMS OR MONOGRAMS.—G. A. SCHLECHTER, Reading, Pa. The aim of this invention is to produce means for securing an emblem or monogram to a watch, watch fob, or similar article. The general purpose is to enable a person wearing an article, to attach to it, an emblem of a society of which he may be a member, or a plate simply carrying his monogram or initial.

TRAP.—N. FROST, Bloomington, Ill. In the present patent the object of the inventor is to provide a new and improved trap for urinals, range closets, and the like, which is very effective in operation, and arranged to permit convenient removal of the traps for cleaning, repairing, and other purposes.

BOOK-MARK.—A. EBERLE, New York, N. Y. —The invention relates more particularly to a book-mark in which a ribbon is employed, one end of the ribbon being adapted to be attached to the book while the opposite end hangs free between the pages. An object is to provide a combined book-mark and page-cutter in which the cutter may serve either as a clamp for fastening the end of the ribbon to the book or as an anchor for holding the lower end of the ribbon in position.

PRESS-BOX.—R. CARLIN, Opelousas, La. The invention is an improvement in press boxes such as are used in extracting oil from cotton seed, and is designed to prevent the flanges from being forced off the press plates by reason of the accumulation of meal on the extended portions of the press blocks, as in the case of the conventional press box.

POLISHER.—I. L. DUNN, New York, N. Y.—The polisher is adapted for use in applying material to shoes and rubbing the same until it acquires a gloss, although the polisher is equally adaptable for use on brasswork, stoves, or any surface, the difference being in the character of material employed and possibly the texture of the surface being polished.

Hardware.

KEY-LOCKING DEVICE.—W. FINN, New York, N. Y. The invention refers to door locks and its object is to provide a key-locking device for convenient attachment to the lock as a keyhole cover, and arranged to securely hold the key against turning from the outside and unlocking of the door by unauthorized persons.

COMBINATION-TOOL. — J. F. O'MALLEY, Avoca, Pa. In this case the invention has reference to a combination tool, and the object of the improvement is to produce a tool of simple construction which can be used as a wrench or hack saw. In its construction the device is embodied with a pair of pliers which also constitute a wire cutter.

SAFETY-RAZOR.—L. B. PRAHAR, New York, N. Y. The object in this instance is to provide a plate with which the blade has sliding engagement, and having end guides or lugs to hold the blade in engagement with the plate as the latter is slid into place, stops to limit the forward movement of the blade, and a spring movable below the plane of the plate and adapted to automatically lock the blade against return movement when the blade reaches the desired position.

Heating and Lighting.

FURNACE-DOOR OPERATOR.—C. A. ANDERSON, Altoona, Pa. While stoking in operating, the door is lifted during the insertion of a shovel full of fuel, and immediately lowered. As the fireman walks from the fuel supply to the furnace with a supply of coal, he depresses the treadle, which opens the door to permit the insertion of fuel, after which the door is immediately dropped. While cleaning the fire, the door may be retained in its uppermost position by means of the pin.

Household Utilities.

UTENSIL-HANDLE.—DE WITT C. HOWARD, Helena, Mont. An object here is to provide a handle for vessels, which can be easily attached to the same in order to convert them into scoops or dippers. The handle can be applied to the vessel, without interfering with the cover or bail of the latter, and can be rapidly and easily attached or detached.

WATER-CLOSET.—N. FROST, Bloomington, Ill. One purpose of the inventor is to provide a direct-acting valve, automatically operated by the raising and lowering of the closet seat, water being received in a tank from a source of supply when the seat is pressed down, and released from the tank to flush the bowl when the seat is free from pressure.

FREEZING APPARATUS.—W. DEGENER, JR., New York, N. Y. The invention relates more particularly to apparatus in which the congealing of liquids by means of cold can be effected, and which includes means controlled by the change of volume of the liquids, due to the congelation, for operating the apparatus to discharge the congealed liquid and replace it with uncongealed liquid.

ATTACHMENT FOR BEDSTEADS.—W. W. ATKINSON, Savannah, Ga. The purpose of the improvement is to provide means for rigidly connecting and supporting the head and front portions of a metal bedstead for the purpose of displaying the same in a window or elsewhere, to enable a free inspection of these portions of a bedstead that is thus exhibited for sale.

BED-RAIL FASTENER.—T. O. BERRY, Big Spring, Texas. Provision is here made for a construction for a bed rail fastener, which affords a secure connection of the ends of the side rails of a metal bedstead with the head and foot posts of the bed; which is inexpensive and that permits the side rails to be changed in their connection with the posts, so as to turn either surface of the rails uppermost and outward, as may be desired.

LEMON-JUICE EXTRACTOR.—W. F. EARLEY, New York, N. Y. The invention relates to lemon juice extractors, and has for its object to provide means simple in construction, effective in operation, and adapted to completely extract the juice from a lemon and separate said juice from the pulp and the seeds of the lemon.

CURTAIN-POLE RING.—F. BARTHOLOMAE, New York, N. Y. The object here is to provide a ring having anti-friction rollers carried in bearings attached to flattened portions of a tubular ring in a very simple and efficient manner, thus permitting convenient and quick assembling of the parts without requiring the employment of highly skilled labor.

FIREPLACE.—T. J. HARPER, Atlanta, Ga. The particular design of the invention is to heat two rooms with a single fire, its object being to produce a fireplace which will thus economize the use of fuel, one which shall consist of two parts and one which can be readily applied, removed, or repaired.

Machines and Mechanical Devices.

LEATHER-SEWING MACHINE.—G. J. MARTIN, Edgewater, N. J. The machine consists of a supporting bar carrying the sewing table, a needle bar connected with the supporting bar by crossed levers, one of the levers having an operating handle for laterally moving the needle bar to and from the supporting bar, and means actuated by the levers to give the shuttle a forward and return movement and to feed material forward as the needle bar moves from the supporting bar.

MECHANICAL MOVEMENT.—DE WITT O. MAKEAN, Binghamton, N. Y. This movement is especially applicable to laundry machines known as extractors, and employed for the speedy separation of the water from the goods after washing and the movement is also applicable for driving felt extractors and other machines, and centrifugal separators for cream, sugar, honey, and like substances.

DISPENSING-MACHINE FOR POST-CARDS AND THE LIKE.—W. D. EVANS and J. T. MARSHALL, Eupora, Miss. The main features here relate to the mechanism whereby a card may be taken from any one of a series of piles by a single dispensing device; whereby a predetermined number may be withdrawn upon the insertion of but one coin; for lifting a card from a pile and conveying it to the delivery opening; for releasing the card from the conveying mechanism and forcing it outward through the delivery opening, and for restacking the cards in each pile after a card has been withdrawn.

VENDING-MACHINE. — W. ASBURY, New York, N. Y. One object of the invention is to provide a machine for selling postal cards and other such merchandise. Another is to provide a machine for selling postal cards and postage stamps at a profit, by means of advertising on or in the envelops containing the stamps or cards. Another is to provide a machine with mechanism by means of which a practical two-coin machine is produced.

ADDING ATTACHMENT FOR TYPE-WRITERS.—H. H. BURTON, Los Angeles, Cal. Some of the more important objects here are to facilitate attachment and detachment of the adding device to and from the numbered key-bars of the typewriter; to provide for adjustment of the device in respect to the numeral key-bars, whereby any numbered wheel may be rotated to different extents by the operations of different key-bars and these amounts accurately determined and controlled; to improve the numeral wheels whereby the numerals may be printed on a larger scale.

WATCH MECHANISM.—R. L. MARSHALL, Elizabethtown, Ky. Mr. Marshall's invention relates to improvements in watch mechanism and more especially to the provision of means for mounting the spring, its arbor, spring box with click and winding wheel made integral or attached thereto and the main driving-wheel of the going train, and for retaining the same in position.

MECHANICAL MOVEMENT.—P. T. MCNALLY, Mandan, N. D. The movement converts simple reciprocating motion into a modified reciprocating motion alternately in two different planes, for various uses in the arts, and it consists in the construction and arrangement of the stationary frame provided with guides for the reciprocating member, in combination with a shifting switch acting automatically to direct the movement.

BORING-MACHINE.—R. WINKLER, Covington, Ky. The invention relates more especially to those machines which are designed to be used in boring holes in the sills of freight cars and similar locations. The primary object is to provide a machine which is free from clamps or levers, which would conflict with the brake connections, chamber rods and floating levers such as are customary in freight cars. It may be held in position by the knees or legs of the operator sitting under-

neath the car, thereby enabling him to use both hands to drive the bit, or else use one to drive the bit and one to produce lever pressure. It has removable handles and removable pressure-sustaining devices so that one side may be free from any lateral projections.

CRANE.—J. A. SUESS, Shreveport, La. This crane will operate to raise a load to a considerable height, and includes an auxiliary lifting device which can be released independently of the main lifting device so as to enable the load to descend a short distance. In this way the convenience of the crane in raising and depositing objects in a shop or factory is greatly enhanced. It is especially useful in ice plants for raising the cans and for moving them to the dump, and then to the vaults.

LOADER.—V. LANDHOLM, Westpoint, Neb. The purpose of this inventor is to provide means which may be adjusted to the fly wheel of a loader of the normal type, by which a drum may be shifted to be rotated by the fly wheel to lift the load or which may be moved against a stationary member which serves as a brake either to hold the load suspended or to permit it to descend slowly.

EXPANSION CUTTER-HEAD FOR BORING-BARS.—C. M. BUCK, Huntington, W. Va. The cutter head is such as used on boring bars and similar devices for performing boring operations. It is intended especially to be used in boring the hubs of car wheels, though it is capable of use for other purposes. The object of the invention is to produce a head having simple means for mounting and adjusting the cutters therein.

POLISHING AND CLEANING MACHINE. M. FORSBERG, New York, N. Y. The machine is for use in hotels, restaurants, shops and other establishments, designed for grinding or cleaning and polishing various articles and implements such as knives, forks, spoons and the like and arranged to permit minute adjustment of the polishing and cleaning wheels according to the nature and form of the articles under treatment.

Musical Devices.

LEAF-TURNER.—J. F. YOUNG, Morristown, N. J. An object of the inventor is to provide a simple music or other leaf turner which is inexpensive to manufacture, and in which the leaf turning arm is provided with a magnet adapted to engage metal clips carried by the leaves, whereby the danger of tearing or injuring the leaves in turning is obviated.

PICKER FOR STRINGED MUSICAL INSTRUMENTS.—E. J. SCARLETT, Chickasha, Okla. Mr. Scarlett's invention relates to attachments for use in stringed instruments whereby the playing of such instruments is facilitated, without detracting in any manner from the quality of the musical sounds produced thereon, and it consists in means that enable an unskilled person to produce results expected by ordinary methods after considerable practice.

STRINGED MUSICAL INSTRUMENT.—S. W. BUERCKLIN, Prague, Okla. The device comprises a hollow resonant body, a sound body at the smaller end of the resonant body, a bridge supported by the sound box and provided with an extending portion engaging the side of the box, means for adjusting the extended portion with respect to the box, a tail piece and a neck supported by the body on opposite sides of the bridge and strings connecting the neck and tail piece and resting upon the bridge.

Prime Movers and Their Accessories.

VALVE-GEAR.—H. LENTZ, 123 Kurfürstendamm, Halensee, Germany, and C. BELLENS, 43 Rue de Chézy, Neuilly, Seine, France. The valve is operated by a cam shaft, and it is characterized particularly by the fact that the shaft is located in a fixed casing, formed with sockets having an external diameter equal to or slightly greater than the largest diameter of the cams to allow of the passage of the same, to the end that by fitting and introducing the shaft into a tubular sleeve it is rendered oil, steam, and dust tight, without assistance of stuffing boxes or like devices.

VALVE-GEAR.—E. L. BOWEN, McComb, Miss. The invention pertains to locomotive engines and other double reversing engines, and its object is to provide a gear arranged to utilize the motion of the cross head of one engine to positively actuate the valve of the other, to provide a constant lead independent of the main traveling movements of the valves, to reduce the effects of angularity to a minimum and to allow of conveniently applying the gear to double reversing engines of different styles.

Pertaining to Vehicles.

LAP-ROBE.—H. T. VON FRANKENBERG, New York, N. Y. The invention relates to lap robes or lap coverings, and more particularly to a robe extensible at the lower portion so that even though the upper portion be tightly folded about the body, the lower portion will permit a certain amount of freedom of movement of the feet to facilitate the operation of the brake, clutch, or the like, of a motor vehicle.

NOTE.—Copies of any of these patents will be furnished by MUNN & CO. for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

Notes and Queries.

Kindly write queries on separate sheets when writing about other matters, such as patents, subscriptions, books, etc. This will facilitate answering your questions. Be sure and give full name and address on every sheet.

Full hints to correspondents were printed at the head of this column in the issue of March 13th or will be sent by mail on request.

(12086) J. C. says: If two equal currents flow in the opposite direction in the same circuit will there be any work done? By this I mean, for instance, if I have two cells connected in a circuit with an electric bell, and the wires connecting these cells are from zinc to zinc and from one carbon through the bell to the other carbon, will the bell ring? A. If two equal currents flow in opposite directions in the same circuit, no external work will be done. The resultant current will be zero. If two cells are connected oppositely to the same circuit there will usually be a slight current in the external circuit because the two cells do not exactly balance each other, that is, one of them has a little more electromotive force than the other and also a different resistance from the other. Very rarely two cells are exactly alike. The difference may not be enough to ring a bell, but it would be indicated upon a sensitive galvanometer.

(12087) B. C. H. asks: Please advise me if in your opinion two cogwheels can be made of different sizes with equal number of cogs in each, the smaller to drive the larger. Say the smaller wheel is 12½ inches in diameter and the larger one 13 inches in diameter, with 36 cogs in each. Can the 12½-inch wheel be made to drive the 13-inch wheel? Could it be done with pinion between them, as indicated by the sketch herewith inclosed? It is intended to run very light machinery. A. We should say that it would be quite impossible to make two intermeshing cogwheels of different diameters with the same number of teeth on each, for the reason that the teeth must necessarily be of different sizes, so that the tooth on one wheel could not fit the space between the teeth on the other. Even with a small pinion between them, as shown in your sketch, the same applies. If the teeth of the pinion meshed satisfactorily with those of one wheel, they would not with those of the other. It is difficult to imagine any mechanical effect which could be obtained by such an arrangement, supposing it were possible, which could not be better obtained otherwise.

(12088) C. C. S. says: Will you kindly help me out of the following difficulty? I wish to electrically operate a set of twenty small bells, using an electro-magnet to each bell, and the number of bells to be sounded at one time varying with the style of music to be played. Can I accomplish this with an electric current from one source of supply, or must I use a separate battery for each bell? Even if the current would equalize through, say, four coils, the E. M. F. necessary for their proper operation would to my mind then be too strong in case of one coil. In case one battery would be sufficient, is it possible to introduce a resistance coil in some way into the circuit to overcome the above difficulty? A. The best arrangement for your bells is to use one current for all with an E. M. F. sufficient for one bell. All the magnets should be wound alike or nearly so, or at least each magnet should be wound to take current enough to ring its bell. Connect all the bells in multiple as lights are connected to a multiple or parallel circuit. The keys or switches to bring a bell into action should be in the circuit from the line to the bell. There will be as many circuits as there are bells. One battery will be sufficient, but it must be strong enough to ring as many bells as will be called for at one time. A keyboard like that of an organ would be very simple and enable one to play any music which does not extend beyond the range of the bells.

(12089) I. W. H. says: 1. How far will the electrolytic wireless receiver described in SCIENTIFIC AMERICAN, volume 94, No. 26, receive messages? A. Any wireless receiver will receive signals from any distance, if they are strong enough to be heard upon it. The electrolytic receiver is very sensitive. 2. How does an operator at the sending station call the operator at the receiving station, with a receiving instrument like this, or any other where a telephone receiver takes the place of a telegraph sounder? A. Every wireless station in regular business has its own call letter which is used when it is wanted. Any one who has the list of stations can tell what station is being called. 3. (a) In the illustration at top of page I notice a "switch" mounted on the base. What is this for? (b) Are the binding posts on the base for connecting the telephone receiver? A. A switch is used with the receiver so that the aerial can be cut out and connected to the transmitter for purposes of sending messages. 4. Are there any parts of this receiver that need renewing after being used awhile? A. The wire used in the electrolytic detector is slowly worn away and will need renewing as well as the zinc and the acid. 5. How is the zinc amalgamated? A. Zinc is amalgamated by dipping it into dilute sulphuric acid and then into mercury. 6. Is Wollaston wire cheaper than platinum wire? A. Wollaston wire is extremely fine platinum wire covered with silver. It costs more than plain platinum wire, but is far better for an electrolytic detector. Coarse wire cannot be used for this purpose. 7. What size wire is used in making the connections for this receiver? A. Any convenient size of copper wire can be used for the connections for this detector. No. 14 will do. 8. How is a "pony" telephone receiver made? A. A pony receiver is one in which the magnet is bent so that both poles are used and have coil of wire upon them. It is more compact and can be attached to a spring and worn on the head. Its resistance may be very high, and it may be very sensitive. This quality is produced by the large number of turns of very fine wire which are wound into its coils.

(12090) R. A. B. says: Please to explain how the velocity of light (186,300 miles per second) was determined, and how this applied in calculating the distance of the sun (499 x 186,300 miles with a possible error of 25 seconds). How is the distance of the moon measured? How far? Is it always the same, and if not, is it known for each day of the month, and what is the mean distance? A. The velocity of light is found by measuring the time required for light to pass over a measured distance. The first determination was made by Romer, who found that light required 499 seconds to come from the sun to the earth. This was done by observing the eclipses of the moons of Jupiter. This work is described in the text books of astronomy. See Moulton's "Astronomy," which is sent for $1.75 postpaid. The best determinations of the speed of light were made in America by Prof. Michelson, and by Prof. Newcomb, independently. They found results differing by only five miles a second. A distance of some six or more miles was used, and the light passed over this distance twice, out and back. There is little doubt that the velocity of light is known to a much greater certainty than 25 miles a second. The velocity of light multiplied by 499 will give the distance of the sun from the earth. The velocity of light may be taken as 186,330 miles per second, which, multiplied by 499, gives the mean or average distance of the earth from the sun. For the experimental determination of the velocity of light see our SUPPLEMENT No. 557, price ten cents. The average distance of the moon from the earth is found to be 238,840 miles. Its distance varies from 221,600 miles to 252,970 miles. The distance of the moon from the earth is determined by simultaneous observations taken at two observatories as far apart north and south as possible. The Cape of Good Hope and Greenwich are observatories thus situated. The method employed may be found in the text books of astronomy. The calculation involves the knowledge of the radius of the earth. Since the shape of the moon's orbit is now known, the distance of the moon from the earth at any hour can be calculated for any time in the future.

(12091) G. S. O'B. says: About four years ago I read the description in the SCIENTIFIC AMERICAN, or its SUPPLEMENT, of a contraption (the name I have forgotten), which would so magnify sound, so it stated, that a fly walking over it sounded like a horse walking on a board floor. My recollection is that it was constructed out of a dry-goods box. It may be that George M. Hopkins was the contributor. I desire to get full description of this sound magnifier. Have you it in SUPPLEMENT form? A. The device about which you inquire is the microphone. It is found in every telephone transmitter and has for many years been used for transmitting speech. It depends for its action upon the fact that the resistance of carbon varies with the pressure upon it. If two pieces of carbon are pressed together the resistance is reduced and more electric current can flow. The sound waves in the voice press upon the carbon in the transmitter and the current fluctuates so as to cause the receiver to reproduce the sounds at the other end of the line. We have published many articles upon the microphone, and can send you any number up to ten for 10 cents each.

(12092) C. A. H. asks: On two occasions I have come across brief references to a device in the form of a tube fitted with a polarizer of tourmaline, whereby the glare of reflected light from water may be eliminated, or at least considerably reduced, so that hidden rocks or other obstructions may be seen when traveling toward the source of light, as when the sun is nearing the horizon. It appears to me that such a device would be very valuable to those who, like myself, run a motor boat in waters obstructed by reefs and shoals. If it is a legitimate request, may I ask you to kindly let me know the address of some firm who could supply the article, and the approximate price of each? A. We do not know any apparatus employing tourmaline for cutting off the glare of sunlight shining from a point dead ahead, nor do we see how polarizing the light could help in that way. Light from the sky at an angle of 90 deg. from the sun is polarized, and tourmaline would disclose that fact and cut down the seeing power, but this is not the case near the sun. It seems to us that smoked glasses would be quite as efficient as polarizing apparatus.

NEW BOOKS, ETC.

THE WAY OF THE WOODS. By Edward Breck. New York: G. P. Putnam's Sons, 1908. 16mo.; 436 pages. Price, $1.75.

Dr. Breck's book is a practical field manual, intended to form a part of the kit of every camper, fisherman, and hunter. It contains concise yet thorough and authoritative information on every subject connected with life in the North Woods, such as outfitting, fishing, shooting, canoeing, tenting, trapping, photography, hygiene, the protection of nature, etc. A unique feature of the volume is that the author tells his readers not only what they should have, but where to find it and what it costs.

SHORT CUTS TO CARPENTRY. By Albert Fair. New York: Industrial Publishing Company, 1908. 90 pp.; 12mo.; ill. with sketches and working drawings. Price, 50 cents.

Much of the matter of this book has appeared in the "Practical Carpenter," where its popularity led to its reproduction in book form, revised and considerably added to by the editor. He starts with the aim of explaining the principle of each of the short cuts explained, generally mathematical but most simply explained, so that the young carpenter may learn the reason for the method and more successfully apply it to "jobs" a little different from the illustrations. The best methods of performing practically every operation required in the carpentry of building and fitting a house are clearly described, and the book should be found very useful either by professional beginner or amateur.

PHRENOLOGY, OR THE DOCTRINE OF THE MENTAL PHENOMENA. By J. G. Spurzheim, M.D., of the Universities of Vienna and Paris, and Licentiate of the Royal College of Physicians of London. With an introduction by Cyrus Elder. Revised Edition from the Second American Edition, in Two Volumes, published in Boston in 1833. Philadelphia and London: J. B. Lippincott Company. 8vo.; pp. 459.

Whether or not we agree with Dr. Alfred Russel Wallace that phrenology "should take its place among the recognized sciences," thereby elevating it to the dignity of a science, we must admit that whatever there may be of science in the study of the conformation of the human head was certainly brought out by Dr. Kaspar Spurzheim. Whether or not we take phrenology seriously, the new edition of this authoritative book seemed more or less necessary, inasmuch as it had been out of print in England for sixty years. Mr. Cyrus Elder has endeavored to remove what he considers prejudices against phrenology in an analytical introduction, in which he replies to criticisms made long ago by Spencer. To us it seems that the physiological psychologists, whatever Mr. Elder may think of them, are more likely to add to the science of the human mind than a serious study of Spurzheim's book, inasmuch as whatever is really scientific in phrenology has been incorporated in physiological psychology.

HANDBUCH FÜR HEER UND FLOTTE. Enzyklopädie der Kriegswissenschaften und verwandter Gebiete. Unter Mitwirkung von Zahlreichen Offizieren, Sanitätsoffizieren, Beamten, Gelehrten, Generalleutnant Z. D. Mit zahl- Herausgegeben von Georg von Alten, Generalleutnant Z. D. Mit Zahlreichen schwarzen und farbigen, Tafeln, Tabellen, Karten, Planen, und Textillustrationen. Berlin, Leipzig, Stuttgart, Wien: Deutsches Verlagshaus, Bong & Co.

This is the third installment of the Handbook of the Army and Navy, which we have previously had occasion to mention. The present volume starts with *Adlerflügel*, and ends with a biography of *Eugen Alberi*.

DESIGN AND CONSTRUCTION OF INDUCTION COILS. By A. Frederick Collins. New York: Munn & Co., 1909. 8vo.; pp. 295; 160 illustrations. Price, $3 net.

Collins's "Design and Construction of Induction Coils" is a timely work. Until the discovery of the Roentgen ray in 1896, the coil was chiefly employed for the exhibition of high-voltage effects—beautiful, but of no practical value. Many colleges did not possess one of any considerable size. The Roentgen ray was closely followed by the invention of wireless telegraphy, and thus other new demands were made upon the induction coil. It was also found that these new duties required new forms and proportions. The induction coil is the result of experiment. The new demands required new experiments to develop a coil which could fulfill these requirements. This book is the result of several years of work in such experiments. No one can turn the pages without being impressed with its practical character. The paper is firm and soft so that it takes the ink perfectly. The type is large and distinct, the print open and well-spaced, the typography is in every way attractive. Closer examination only confirms the first impression. The book commends itself to the mechanician and the scientific man alike. It does not proceed by the deduction of mathematical formulas for the calculation of the

different parts of a coil, since such formulas have proved a very poor reliance when applied to an actual case. Slight differences in quality of material and sizes, or in thickness of insulation may lead one astray in the rigid application of a formula. Mr. Collins has taken up each part of an induction coil by itself and has discussed its size, construction, and adaptation to the other parts in a most complete and satisfactory manner. The best proportions are given for a series of coils giving a spark of twelve inches and under. Higher than this it is not necessary to go, since one requiring more energy than can be converted by a coil giving a spark twelve inches long will use a transformer and not an induction coil. The different uses of a coil are also considered and such variations as are necessary to adapt a coil to Roentgen-ray or wireless telegraph work are given. Of course these differences are principally in the secondary winding, where will be found in separate columns the data for these two services. This is a very important advantage of this book over other books recently published upon this subject. One cannot but notice the care with which small details are worked out. The numerous cuts show every separate piece in fullness and completeness. The volume contains 160 illustrations, while a single illustration may contain as many as 21 cuts as does the one on page 101, illustrating the construction of an interrupter. The data furnished in the form of tables are quite as full. Of tables there are 122, containing the sizes and dimensions of every detail of every part of an induction coil, and also the prices of every kind of material to enter into it. It is difficult to see how any one with the slightest skill in the use of tools can fail to build a good coil under the guidance this book affords. We believe it will displace all other books upon this subject.

THE MANUAL OF STATISTICS. Stock Exchange Handbook. New York: The Manual of Statistics Company, 1909. 12mo.; 1194 pp. Price, $5.

The thirty-first annual issue deals with railroad securities, industrial securities, government securities, stock exchange quotations, mining, grain, provisions, cotton, money, bank and trust companies. It is admirably printed and the maps are clear and numerous. The information conveyed is of exactly the nature which is of almost daily request in offices where financial matters are of any moment. It should be on the desk of every railway and bank official.

THE BANKING AND CURRENCY PROBLEM IN THE UNITED STATES. By Victor Morawetz. New York: North American Review Publishing Company. 12mo.

The author of this book, Mr. Victor Morawetz, is an authority on corporations and finance. His book is chiefly concerned with solving the problem of currency shortage, which seems to confront this country at recurring periods. He advances a plan for cooperation between the banks and the Treasury, which includes a note redemption fund to be elastic, regulating the uncovered volume of notes outstanding, and thus giving stability to financial institutions generally.

THE NEW BUILDING ESTIMATOR. A Practical Guide to Estimating the Cost of Labor and Maferial in Building Construction, from Excavation to Finish, with Various Practical Examples of Work presented in Detail, and with Labor Figured Chiefly in Hours and Quantities. A Handbook for Architects, Builders, Contractors, Appraisers, Engineers, Superintendents, and Draftsmen. By William Arthur, Box 482, Omaha, Neb. New York: Published by David Williams Company.

Probably no task requires nicer judgment on the part of the engineer or architect than the estimation of building costs. For this reason any book which will materially help him in solving the peculiar problems which are presented to him must be welcomed. Mr. Arthur in his previous edition has demonstrated the fact that he is certainly competent to guide the estimating engineer and architect. The new edition of his book brings the prices up to date and incorporates much new tabulated matter.

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SOME NEW AMERICAN AEROPLANES.

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plane he has made use of eight of these propellers, and has arranged them in a line between the two planes, the idea being to give a propulsive effort throughout the entire width of the machine. It has also been proven that a number of small propellers will give a greater thrust per horse-power than one or two large ones. Mr. Kimball makes use of the same motor and wire-rope drive that he employed in his helicopter; but he has improved upon this drive by installing a friction clutch between the driving drum of the motor and the driven drum carrying the wire ropes. The clutch consists of a cast-iron floating ring, and also of a leather lining in these two drums. It allows a certain amount of slipping to occur at the start, so that the propellers are not strained and broken as before. It is also set so that it will slip with a 25 per cent overload. This improvement, according to the inventor, has made a rope drive for aeroplanes entirely practicable. The wire rope used is only ⅛ of an inch in diameter, and consists of six strands, each of which contains 19 wires. The rope has a tensile strength of 2,000 pounds, while the pull to which it is actually submitted is only 80 to 90 pounds. There are two endless cables, one for each set of four propellers. They are held under proper tension by a single idler for each one. The motor makes 1,900 revolutions per minute to 1,600 of the propeller, and the cable travels at the rate of 7,500 feet per minute, or about 86 miles an hour. The propellers have four blades each. They are 3 feet 10 inches in diameter, and have a pitch of 4 feet. The thrust obtained is about 175 pounds. The motor is a four-cylinder, two-cycle engine of an improved type, the cylinders being 4 x 4. It develops 50 horse-power at 2,000 R.P.M.

The main planes of the Kimball machine are 37 feet by 6½ feet, and they are spaced 4 feet 2 inches apart. They have a very slight curve of about 1 in 26, and their angle of incidence is about 5 deg. The rear edges project out 18 inches beyond the main plane and are rather flexible. The machine is provided with movable wing tips, 4 by 4 feet in size, on the ends of both planes. There is a double-surface horizontal rudder in front, 12 by 2½ feet in size, the planes of which are spaced 3 feet apart. This rudder is located 9¾ feet in front of the main planes. It is operated by a lever convenient to the right hand of the aviator, while another lever worked by the left hand operates the two sets of four vertical rudders each, placed on the rear of the movable wing tips. This lever also operates the front wheel, in order to steer when running on the ground.

The main features of the Kimball aeroplane are the use of multiple propellers and fitting of quadruple vertical rudders close to the main planes, near their extremities. If the inventor can run his propellers at a high enough speed to obtain from 300 to 400 pounds thrust, he will probably be able to get in the air; but at the present writing he has made only one attempt, which was unsuccessful in this respect.

MAKING THE EYE OF SCIENCE.

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of the proper shape and curvature.

But, you will want to know, how does the workman know when the glass to be tested fits the test glass? It is in this "how" that the exquisite fineness of the test resides, for the beautiful phenomena of Newton's rings comes into play here. Any extremely thin and attenuated film will show diffraction colors—soap bubbles are common examples. Every child knows that the bigger the bubble, the more beautiful the colors, and the grown-up knows that the bigger the bubble, the thinner the film. When the glass to be tested is laid in the test-glass hollow, there is a thin film of air left between

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them. If this thin film of air is of even thickness throughout, the lens will be filled with a glow of color which changes as pressure may be brought to bear on the lens, thus thinning the film of air. If this glow is but one color and with no colorless patches, it is evident that the lens fits the glass perfectly; if the color is in bands or rings, or if more than one color shows, it is equally evident that the lens does not fit over all its surface, and consequently is not accurately ground and polished. This is the most delicate test known to science for equality of surfaces, and, if properly done, is absolutely reliable.

Microscopic objectives are tested in other ways. A 1/12-inch objective possesses a front element so small as to be seen with difficulty. It is actually 1/7 millimeter in diameter. This is too minute to admit of using the color test. These tiny lenses are ground by workmen of whom there are hardly ten in the world—men who have spent their lives over the tiny lathes and shells which grind hemispheres of glass of such exceeding smallness as this. It is more by feeling and intuition than by examination with magnifiers that they know when such lenses are true and perfect to their shells, but it is the fine optical and visual test on a diatom of fine markings and infinitely small size, such as *Amphipleura pellucida* or *Pleurosigma angulatum*, which determines their degree of perfection.

When all the elements of a fine anastigmatic photographic lens are ground, they have then to be cemented together, if it is a cemented lens, and, most important of operations, trimmed so that the optical center and the mechanical center of the several individual elements coincide. While the clear Canada balsam cement is yet "green," the glasses are revolved on a lathe, and the workman observes in them a reflection of a light source—in the illustration, a burning gas-jet held in the hand. When the optical centers of the lenses do not correspond with the center of revolution or mechanical center, the reflected image dances. The cement is softened with heat and, by pushing on the edges of the revolving lenses, the operator makes them move against each other until the flame is reflected perfectly, and remains absolutely stationary while the lens revolves. When this condition is obtained the cement is allowed to harden, and the edges of the lenses are trimmed away with a diamond cutter.

The several lenses which compose a fine microscopic objective are not only centered and trimmed, but mounted, on one lathe and by one man, who also makes the mounting. This departure from the modern factory practice of "one man, one job," has been found necessary because no two lathes, be they ever so accurately made, revolve in exactly the same way, and if a lens be trimmed by one lathe and mounted in brass cells made on another lathe, the mechanical and optical centers will not align perfectly.

A 1/12-inch microscpoic objective is a collection of lens elements, the magnifying power of which is equivalent to a single lens of 1/12-inch focus or about 120 diameters. Its working distance, i. e., the distance the front element has to be from the object viewed, may be slightly greater or less than 1/12 inch. With an eyepiece of ½-inch focus, such a lens will give a magnification in the microscope of 2,400 diameters, or 5,760,000 times. In other words, if a diatom could be enlarged in wax as much bigger than the original as the image of it is greater than it is itself, by such an equipment as is described above, it would hold on its surface 5,760,000 diatoms.

It is obvious that any error in the making of such a lens is magnified equally with the object. If the lenses are in the least degree decentered, the amount of error is magnified according

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to the magnification of the object seen. It is essential, therefore, that the mounting be absolutely accurate, a condition satisfied by using the same lathe for both making the mount and trimming the lenses of the objective.

A photographic lens of high quality must pass tests of great difficulty and searching power. It is put in a camera and tried out on an accurate chart, and must "cover" a certain area of this chart at a certain distance, while rendering the image perfectly flat and without distortion. Uncorrected photographic lenses have a great many aberrations—curvature of the field, spherical aberration, coma, flare, astigmatism, curvilinear distortion, chromatic aberration; and a good photographic lens must be without these, or it fails to pass its tests. In the optical factory in which the illustrations for this article were made, every photographic lens is provided with a ticket, and on this chart the expert lens examiners put down a check mark against every fault or aberration of the lens under examination. A perfect lens, such as is marketed, shows on its chart nothing more damaging than the presence of a few minute air bubbles, impossible to avoid in the special optical glass which is used in the production of "anastigmats." These air bubbles, often giving great concern to purchasers who do not understand their harmlessness, do nothing more damaging than to decrease the light-passing capacity of the lens by a percentage equal to the percentage their area is to the area of the lens—a small fraction of one per cent.

In addition to testing out for optical aberrations, the tester hunts for striæ, streaks in the glass, for strains, for improper centering, for imperfections of cementing, for poor mounting, for defects in the glass not classified, as scratches and marred places, so that, when a lens has finally passed the inspector, it is a perfect specimen so far as human ingenuity can make it.

Microscopic objectives, on the work of any one of which may depend not only the success of scientific experiments and the obtaining of new knowledge in a hundred branches, but even human lives, are the subject of the most minute care in testing. An unskilled observer may find it difficult to distinguish between the image made by a poor and a good one-twelfth, but the scientist who uses it, and equally with him the trained man who examines it before its being put in stock, has no difficulty in finding out from the severe test objects whether it will properly "resolve" the fine markings on a diatom, whether it has "color fringes" or not, whether its field is flat or not.

Lens calculated, glass selected, shells and blocks carefully machined, glass ground once, twice, and again, lens elements tested, repolished or ground if necessary, centered, mounted, again tested, charted, and reinspected, the glass eyes of the microscope and the camera, twin eyes of science and the two most important tools in the laboratory, go from the factory all over the world to the laboratories where are made a large per cent of all the discoveries in science of all kinds, but particularly in the natural sciences and in all those departments of human knowledge which have to do with the body and with health and the cure of disease. And all the work done in these laboratories depends in the first instance on a little bit of glass, a mathematical formula, and the precision with which the glass can be made to fit the $x^2 n^2$ of the master optician.

Testing Ancient Bronzes.

Old objects of bronze and copper are usually covered with thick layers of oxide which make it impossible to recognize the true character of the metal or alloy. The removal of this highly valued patina is not generally allowable, and the metallic surface that may be exposed at sharp

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Gas engine, E. J. Gulick	923,046
Gas extractor and mine ventilator, G. Laws	922,603
Gas machines, interlocking device for, L. H. Miller	923,063
Gas, manufacturing, W. H. Cone	922,857
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Grading attachment for vehicles, road, W. S. Livengood	922,493
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Gripper attachment, J. R. Grove	922,762
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Gun, recoil, Lauber & Bominghaus	923,051
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Harness suspending means, J. Howard	922,904
Harrow or cultivator, J. Courtenay	922,671
Harvester, potato, L. Kniffen	922,915
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Hoisting and conveying apparatus, A. E. Norris	922,807
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Mashing machine, A. R. Keller	922,486
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Pulverizing roller, E. E. Porter 922,505, 922,506
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Recorder. See Time recorder.
Register, J. Frick 922,876
Registering the mean working pressure, indicator for continuously, M. Arndt 922,553
Relay, cable, I. Kitsee 922,780
Rock drilling engine, water feed, dust laying, C. H. Shaw 922,526
Roller, harrow, and cultivator, combined, O. A. Hallatin 922,469
Rosette, E. Tregoning 922,977
Rotor construction, E. Mattman 922,794
Roundabout, C. D. Sauve 922,723
Rug holder, porous, C. E. Knapp 922,703
Rule, C. Hansen 922,580
Sad iron heater, W. A. Flatt 922,872
Saddle spring, harness, W. H. Aldo 923,102
Safety device, automatic, W. D. Gelser 922,881
Salt cellar, H. J. Trimble 922,978
Sand blast device, S. L. Young 923,100
Sandpaper wheel, W. G. Liebig 922,491
Santolol esters, E. Sprongerts 922,538
Sash and window locking device, ventilating, F. W. Held 922,901
Sash lock, automatic, E. Held 922,894
Sash lock, window, H. L. Corson 922,670
Sash locking device, J. E. Gibbs 922,882
Sash or screen hanger, storm, Peters & Grant 922,625, 922,720
Saw blades and means for attachment of the saw blade thereto, cap plate for cylindrical, Williams & Wegner 922,650
Saw blades and the attachment of the saw blade thereto, cap plate for cylindrical, Williams & Wegner 922,649
Saw grinder attachment, G. W. Pippen 922,504
Saw mills, setting mechanism for twin band, C. E. Cleveland 922,855
Saws, sawdust catching attachment for circular, D. J. Benillier 922,840
Scaffold and derrick, adjustable, M. Bailer 923,002
Seal, snap, E. J. Brooks 923,014, 923,015
Separator sieve, H. Shupert 922,732
Sewing machine, binding, J. P. Wels 922,646
Sewing machine feed mechanism, F. W. Merrick 923,062
Sewing machine needle plate, N. Woolsey 922,744
Sewing machine take up, F. F. Dorsey 923,031
Sewing machine thread controlling mechanism, button, R. T. Levesque 922,786
Shade bracket, H. Arnold 923,000
Shaft collar, G. A. Donahue 922,463
Shaft coupling, E. C. Griffin 922,579
Shafts, machine for cutting keyways in, Goad & Hayes 922,691
Shear table and actuating mechanism therefor, F. C. Biggert 923,109
Ship's draft indicating means, F. J. Mentz 922,933
Shoe, J. E. Shawhan 923,083
Shoe cleaning device, R. Henry 922,479
Shoe fastener, C. P. Toplift 922,976
Show case, L. Spady 922,820
Sight, J. T. Peddie 922,945
Sign holder, G. Hunerjager 922,760
Sign, illuminated, M. C. Ryan 922,958
Sign, movable advertising, J. H. La Pearl 922,784
Signaling system, J. Means 922,700
Siphon, W. Harrison 922,698
Skate, A. J. Kennedy 922,774

points and edges is too small to afford the desired indications. Two German investigators, having found that pure copper and bronzes containing various proportions of tin give characteristic streaks when rubbed on a touchstone, have devised a method of determining approximately the composition of any bronze object by comparing its streak with those made by a series of bronze bars of known composition. In practice, four such bars are found sufficient. The four bars are rubbed on the touchstone (Lydian slate or polished biscuit ware) and by the side of the four marks a fifth is made with a point or edge of the object under investigation. Pure copper gives a pure red streak, but a tinge of yellow is added by as little as 1 per cent of tin.

Chemical analyses of prehistoric bronze show percentages of tin ranging from 1.5 to 30, but very few specimens contain less than 6 or more than 12 per cent of tin. Silver, lead, antimony, arsenic, bismuth, nickel, and cobalt occur only in traces, and the proportion of iron is also very small in most cases. It is a remarkable fact that nearly all prehistoric bronzes are very nearly or quite free from zinc, of which many modern bronzes contain as much as 10 per cent.—Umschau.

America's Heavy Fire Loss.

At the forty-third annual meeting of the National Board of Fire Underwriters, held in New York city May 13th, President J. Montgomery Hare made an address, in which he stated that a comparison with statistics of losses in foreign countries shows that the loss per capita in the United States is from 10 to 30 times greater than in the principal European cities. For the last five years, he said, the annual fire loss in this country has averaged $269,200,412, the total for the period being $1,346,022,059, or about three-quarters of a million for each day of the five years. In this period the figures were largely increased by the San Francisco conflagration, but even taking the two years since then the losses have kept well above the $200,000,000 mark.

Without counting losses from forest fires, the destruction of property in 1907 by fire totaled $250,084,709, and in 1908, $217,885,850. The figures for this year give no promise of improvement, President Hare said, having reached a total of nearly $53,000,000 for the first three months.

According to dispatches from Atlanta, nothing which has been suggested for the benefit of the South since the war has aroused such unanimous enthusiasm as the proposed highway from New York to Atlanta. Whereas the suggestion originated with automobile users, it is obvious that any scheme for the promotion of good roads through country districts remote from railroads must directly benefit agricultural and other large communities largely dependent upon highways for transportation. Three alternative routes have been suggested, all of which follow the same course from New York to Philadelphia. Two routes thence to Washington are identical, whence one lies through Rapidan, Charlottesville, Lynchburg, Danville, Greensboro, and Salisbury, where it joins the third route and reaches Atlanta *via* Charlotte, Blackburg, Spartansburg, Hartwell, and Winder; while the other goes through Richmond, Petersburg, Raleigh, Columbia, S. C., and Royton to Winder. The third route leaves Philadelphia westward to Harrisburg, thence down the Cumberland and Shenandoah valleys to Harper's Ferry and Lexington, crossing the mountains to Martinsburg and Salisbury and continuing as above. The New York Herald and Atlanta Journal have offered prizes for the best sections of road in the various districts, and an endurance test for automobiles is projected, with the object of comparing the results on different routes, the ultimate decision as to the highway route being dependent upon the local road conditions achieved by local authorities.

Skirt marker, Wells & Meek	922,740
Skirt marker, J. D'Ella	923,029
Slack adjuster, automatic, C. O. Anderson	922,552
Sleeve, splicing, H. Frankel	922,690
Slicing machine, bread, G. A. Kinder	923,125
Sliding gate, W. W. Wasden	922,548
Slip coupling, E. J. Gulick	923,043
Smoke consuming furnace, P. J. Flanagan	922,871
Snap hook, W. Gronke	922,473
Soap holder, liquid, H. W. Burgner	922,453
Socket fastener, E. L. Miller	922,936
Soy or sauce substitute, manufacturing, K. Okazaki	923,070
Speculum, C. H. Borden	922,845
Speed adjuster, L. R. Culver	922,674
Speed controller, W. J. Seitz	922,525
Spindle, J. N. Kelsea	922,912
Spoke, T. H. Walbridge	922,737
Spring wheel, E. B. Anderson	922,658
Spring winding tool, A. Worcester	922,650
Sprinkler system, automatic, J. P. Casey	922,456
Stadia reading apparatus, E. J. Young	922,833
Stalk cutter, raspberry and similar, M. B. Sherman	922,529
Station indicator, H. C. Wallace	922,984
Steam generator, H. Ritchie	922,817
Steam generator and heater, F. L. Dutcher	923,034
Stencil machine, G. Remusnifer	922,815
Stoves, lamps, etc., attachment for gas, W. A. Caldwell, Jr.	922,666
Strain resisting mechanism, G. H. Forsyth	923,040
Strainer for lubricating systems, C. H. Worsey	922,657
Stream motor, R. Wilson	922,652
Stream motor, P. J. Hansen	922,890
Street cleaning machine, F. B. Dickason	922,677
Suit case, attachment, T. Cosgrove	922,567
Sulfocyanids, manufacture of, K. M. Chance	922,564
Surgical device, C. E. Eckrode	923,118
Swing attachment, M. R. Grant	922,886
Switch. See Electric switch.	
Tabulating mechanism, S. J. Quincy	922,812
Tag or check, A. S. Rheaume	922,510
Talking machine stand and horn, combined, H. C. Miller, reissue	12,963
Tank heater and feed cooker, J. S. Christensen	922,457
Tank indicator, liquid fuel, S. H. Peckham	923,073
Target trap, S. A. Huntley	922,588
Teazling cloth, etc., device for, S. Grimson	922,887
Telegraph, printing, I. Kitsee	922,781
Telegraph transmitter, T. J. Dunn	923,033
Telegraphy, T. B. Dixon	922,462
Telephone system, A. H. Dyson	923,035
Telescope for indicating ships' oscillations, sighting, H. C. Mustin	922,938
Telescope, hinged double, E. Donitz	922,679
Theatrical effects, means for producing, A. F. Smile	922,722
Thermoplastic keratin composition, B. B. Goldsmith	922,692
Threshing machine feeder, J. H. Schlenter	922,520
Threshing machine separator, R. McLaughlin	922,615
Ticket, railway, R. A. Smith	922,818
Ties, means for securing splice bars to, M. F. Bonzano	923,007
Time recorder, A. P. Schmucker	922,633
Tire cover, spare, H. Cohen	922,669
Tire, pneumatic, F. Reddaway	922,631
Tire protector, E. J. Weldner	922,739
Tire tool, J. A. Swinehart	922,541
Tire, vehicle, A. M. MacFarland	923,059
Tire, wheel, A. R. Bangs	923,104
Tool, hand, A. G. Lamb	922,902
Toy, L. W. King	922,775
Toy spinner, W. Bohn	922,842
Toy vehicle, H. T. Kingsbury	922,914
Toy, wheeled, J. B. Spencer	922,639
Trace fastener, B. F. Woodhouse	922,992
Train or vehicle, electric, J. L. Creveling	922,752
Transportation system, elevated, A. E. Brock	922,662
Trowel, J. W. Denton	922,676
Truck, car, C. S. Shallenberger	922,966, 922,967
Truck, railway, A. M. Clark	922,750
Tube forming machine, L. C. Smith	922,536
Turbine, elastic fluid, Hanzlik & Hellmer	922,581
Turbines, nozzle for elastic fluid, J. G. Callan	922,562
Turn table, H. M. Verplanck	922,643
Type bar, justified, F. H. Richards	922,632
Type ribbon handling device, E. C. Magnus	922,927
Typewriting and calculating machine, combined, H. D. Bolton	922,559
Typewriting machine, G. C. Carhart	923,016
Typewriting machine, O. Woodward	923,099
Typewriting machine, E. E. Barney	923,106
Typewriting machine, F. W. Hillard, 923,120,	923,121
Typewriting machines, decimal spacing mechanism for, Laganke & Smith	922,601
Typewriting machines, variable carriage feed for, J. A. Smith	922,534
Umbrella, folding, A. Loukota	922,925
Valve, C. F. Fernald	922,686
Valve, W. C. Westaway	922,986
Valve, automatic shut off, A. T. Gries	922,578
Valve, gate, A. P. Smith	922,636
Valve lock, L. Toback	923,080
Vamp trimming machine, J. B. Hadaway	922,697
Varnish gum and producing same, J. J. Kessler	922,596
Vehicle brake operating mechanism, motor, P. Krause	922,916
Vehicle exhaust dissipating apparatus, motor, G. E. Whitney	922,741
Vehicle for hospital and other purposes, W. F. Bernstein	922,841
Vehicle front or platform gear, J. Erret	922,869
Vehicle spring, L. C. Burnet	922,454
Vehicle spring, E. L. Barton	923,107
Vehicle steering and turning device, J. M. Eadle	922,757
Vehicle wheel, E. S. Kintz	922,597
Vehicles, device for automatically stopping, S. H. Claxton	923,020
Velocipede, R. V. Jones	922,484
Veneering drying apparatus, G. M. Walker	922,983
Vessel hull construction, E. S. Hough	922,907
Vibrating screen or separator, Bell & Sturtevant	923,108
Vise, bench, P. F. Wray	923,098
Voltage controller, multiple, E. W. Stull	922,925
Voting machine, B. F. Ellerman, et al	922,683
Wagon brace, dump, P. H. Scentgen	922,969
Wagon jack, G. W. Harris	922,474
Wagon seat, A. A. Vik	922,546
Washer. See Dish washer.	
Washer or button feeding attachment for setting machines, E. B. Stimpson	922,640
Washing machine, A. Hofmann	922,900
Washing machine, G. R. Adams	923,101
Watch, A. Pfister	922,809
Water closet seat, W. S. Emery	923,039
Water glass, White & Hof	922,829
Watering device, stock, G. E. Odell	922,943
Watering tank, stock, A. N. Eaton	922,681
Wax extracting apparatus, Smith & Waterhouse	922,637
Weather strip, C. B. Ford	922,873
Welding, electric, M. Lachman	923,128
Welding of aluminium, flux for the autogenous, M. U. Schoop	922,523
Wheel, G. M. Badger	923,001
Winding and cleaning silk and other fibers, apparatus for, E. Dubini	923,032
Winding machine guide motion, quill, E. E. Bradley	922,848
Window fastening device, L. H. Vogel	922,644
Window lock, J. E. Hissong	922,899
Window pane fastener, J. B. La Venture	922,785
Wire bed bottom, woven, G. Boehm	923,006
Wire drawing, plate stand for, P. Vanderauwera	922,979
Wire gripper, J. H. Reece	922,814
Woven fabric, T. Taylor	922,641
Wrench, Bean & Baldwin	923,103

A printed copy of the specification and drawing of any patent in the foregoing list, or any patent in print issued since 1865, will be furnished from this office for 10 cents, provided the name and number of the patent desired and the date be given. Address Munn & Co., 361 Broadway, New York.

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